THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1906 Edition

NOW READY.

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THE COMPULSORY USE OF JACKS ON TRAMWAYS.

ARISING out of a fatal accident on the Birmingham and Midland Tramways, Col. Yorke recently held an inquiry touching the questions: Why the lifeguard did not protect the child, and why 35 minutes elapsed before the body was released?

Feeling in the district is unfavourable to the company, because there was no jack on the car, and because it is not the practice of the company to put jacks on cars as a rule, except when necessary to comply with local police regulations.

Col. Yorke said that he failed to see in what way jacks would be of service, that in any event it would be enough to place them in convenient positions along the route instead of keeping one on every car, but that the Board of Trade would have to consider the whole matter carefully, as anything they recommended must apply to the whole country.

We agree with the Inspector that to require every car to carry a jack would be a somewhat unfair burden, at least where the service of cars is frequent; but there would be little hardship in requiring suitable lifting appliances (and, perhaps, other emergency tools) to be kept in a locked receptacle at intervals of half a mile along every route. The first cost of the necessary tools would be small, and the upkeep of the depôts negligible if the usual precautions, such as apply to street fire-alarm and hydrant stations, were observed, and we are not convinced that occasions do not arise and will not continue to arise upon which the presence of a jack might not be the means of saving human life. For instance, it is imaginable that a child might be pinned in such a way as to make further movement of the car out of the question if he is not to be mangled further, and it is always the case even when the body is already torn to pieces and life inevitably extinct that it is disentangled reverently, if necessary at the trouble of dismantling the truck, rather than allowing it to be freed more speedily but lacerated more frightfully by the simple forward or backward motion of the car; but it is imaginable we say that the child—or man, for the matter of that, let us say the reader or the writer—is not killed immediately, but is bleeding to death, or has limb or skull fractured, in which case would not a handy jack be of the utmost consequence at that time?

Whether death is instantaneous or lingering, it is the duty of the owners of the tramway to extricate the body with the least possible delay; and we regret to say that in too many instances the interval during which the public has been shocked or the victim agonised is inhumanly long, and while deprecating the per-fervid, and therefore unbalanced, language in which the lay Press has indulged on this and on similar occasions, we have much sympathy

with the cause, and believe that the proper sentiments of humanity should not be exposed to any risk of outrage for the sake of a few pounds spent on tools.

THE WIRELESS TELEGRAPHY BILL.

DURING the past week considerable attention has been given in the Press to the subject of the Bill now before Parliament to extend the "Wireless Telegraphy Act, 1904." The provisions of the Act expire in July, and the Bill sought to extend them to 1912, but amendments were accepted by the Government reducing the extension to 1909. The Bill passed the Commons, and has now been read a third time in the House of Lords.

With a view to the enlightenment of their Lordships, a circular was sent by Lloyd's to every peer. The circular is published in the *Times* of the 18th inst., and is followed by a rejoinder from the Marconi Co. The object of Lloyd's circular is expressed in the final paragraph:—"The Committee of Lloyd's, therefore, most earnestly and urgently trust that the Bill which is now before the House of Lords for the extension of the Wireless Telegraphy Act may be rejected;"—but the reasons given are less cogent than the conclusion. Lloyd's has a history, and has, in its time, rendered service to the State; its collection and transmission of information is of the greatest importance in regard to the safety of life and the welfare of the shipping industry, but as, in the past, Lloyd's has been able to carry on its valuable service without being a law unto itself as regards methods of transmission, it is not easy to see why it should claim such freedom now.

The Wireless Telegraphy Act was passed to regulate the transmission of wireless messages to the benefit of the State. The statements made by the Marconi Co. would seem to show that Lloyd's are well protected for the transmission of their information through existing or future Marconi sources, and as, at the present time, there is every reason to believe that the establishment of contiguous stations would, or might, interfere with effective transmission, it would really seem that the reliability which Lloyd's require is better attained by the continuance of regulations which they seek to upset. The selection of systems and the nationality of the inventors or controllers are different questions altogether, and we think it regrettable that Lloyd's should introduce such points in a way which might give the impression that it is sought to prejudice the issue.

Refuse Destructors.

As we stated in our issue of May 11th, a memorial was recently presented to Parliament by His Majesty's Office of Works, calling attention to the Electric Power and Supply Bills and the smoke nuisance.

To the uninitiated the name "Office of Works" might suggest a large Government building, full of electrical and other engineers told off to promote and regulate engineering operations throughout His Majesty's dominions. In this case, however, the Commissioners appear rather as landscape gardeners, and the expert upon whom they rely is an eminent chemist, Dr. Thorpe.

The present occasion has, as a matter of course, been seized by gas engine advocates, who point with effect to the superior economy of internal combustion engines, and to the value of gas generating plant combined with the recovery of residuals by purifying the gas, so that the products of combustion are made harmless and invisible.

Engineers interested in steam plant, particularly boiler-makers, would do well to lay these matters to heart, while there is yet time; or they may find the prophecy of the late Sir Frederick Bramwell that steam engines and boilers would be relegated to the museums in 20 years coming true in a manner very inconvenient to themselves.

One statement in the memorandum, standing quite alone and unsupported, calls for the absolute prohibition of the use of "dust destructor refuse" as fuel.

This sweeping recommendation is not backed up by any evidence of its value or utility. If the words are taken quite literally, they appear to refer to clinkers, which are the only refuse from destructors, but it is only fair to suppose that "town refuse" is meant, and that it is the combination of destructors with power works which the Commissioners desire to prohibit.

But surely by this time it is admitted that destructors are a sanitary necessity, and that they can be worked without any nuisance to their surroundings; and we think it will be admitted further that they are no more likely to be a nuisance when combined with power stations. Rather it should be the contrary, seeing that combined destructors come under the control of skilled central station engineers. The fact that the hot gases are used to raise steam will be to the advantage of the surroundings rather than the contrary.

Perhaps, after all, the recommendation is not aimed at properly constructed destructors, but only at the burning of town refuse on ordinary boiler grates, or in brick clamps and kilns, and if this be the case, we are in hearty agreement with the Commissioners.

Rail Welding.

RAIL welding has taken a good hold in England at last, and the simplest form of it is the only one which has lasted; but there are many miles of old track which might be saved for several years, and the average life of rails generally might be raised from 13 or 15 years to 20, if resort were had to joint welding.

We know that the Americans have been content with track much inferior to our standard, but their street railways have been overburdened with no more surplus than ours, and they have had to turn rather sooner than ourselves to devices for spinning out the life of the rails.

Therefore, if we want to know anything about rail-welding we look to America for the information.

Good evidence of the life-saving qualities of the welded-joint was contained in a recent number of the *Street Railway Review* concerning some 58 lb. girder tram rails 5 in. high and having a base no more than 3¼ in. wide, which were run upon for six years, until the joints were so bad that the car-wheels first touched the "receiving" rail 4 in. from the end. Then all the joints were cast-welded, and after five years more life, and not until the wheel flanges had cut ⅛ in. into the "tram" or "step" were the rails taken out.

We have nothing to say about the policy of keeping rails in service until the joints are in such a frightful condition as that indicated above, but it must be evident that even in an American street railway those rails could not have lasted any longer unless the joints had been lined up and welded.

It would be interesting to know how the cost of car repairs compares during the 4-in. leap every 30 ft. period and after.

We have to remember that rail salvage is often possible under the conditions which prevail in the greater number of

American street railways when it would be out of the question in England. First of all the standards of permissible wear are different, the use of bogie-cars disguises bad joints, and paving such as we know it, is rare. Probably an English undertaking setting to work to weld rails as bad as in the case noted, would find that, in the absence of efficient anchors, the whole length of rail was so "hogged" that a really paying job could not be made even after the joints were put right; but that is only an additional and a very strong reason for taking care that the rails are welded before it is too late; and there are hundreds of miles of tramways in England at the present moment, which are calling out for the stitch in time, although it may be that the average running life of the rails at this date is not more than four years.

Moore v. City of London Electric Lighting Co.

It has always been a matter of some surprise to us that electric lighting companies are so lax in the manner of running their cables on consumers' premises. Whilst they make regulations that contractors' cables must be in casing or piping, these rules are not always observed by themselves.

A case in which this point was raised came before Sir Forrest Fulton and a jury at the Lord Mayor's Court last Monday. It appears that Messrs. Austin & Co. were carrying out an installation for Messrs. Nestlés in St. George's House, Eastcheap. The City Electric Lighting Co.'s mains were brought in by concentric cable in the ordinary way to a cast-iron connection box, from which vulcanised cables were taken to two service fuses. The cables between the connection box and the fuses were of highly insulated vulcanised cable, but were not covered in any way by casing or piping. Austin's leading hand, a man named Moore, in running his casing, moved one of these cables; and, whether he applied much or little force—a matter which was disputed in evidence—the result was that the cable came adrift from the connection box, arced on to the cast-iron cover, burned Moore's clothes and arm and caused him to lose several weeks' employment in consequence.

Moore, thereupon, sued the City Co. for damages, alleging negligence in their not having made a proper connection and not having properly protected their wires. A good deal of evidence was given on both sides as to the proper form of connection to use; that is, as to whether or not connections on large cables ought to be by means of sweating sockets or by screwed terminals, as is the common practice with the City Co. The City Co., represented by their inspector, Mr. Moore, maintained that their method of connection was what they had found by experience to be the best for the purpose, and argued that it could not have been loose, as maintained by the plaintiff, or some signs of heating would have been apparent. The main line of defence, however, was that the plaintiff had no right whatever to touch the defendants' cables, as it is clearly stipulated in their rules that their cables must not be touched in any way except by their own men.

The company called Mr. Frank Broadbent as an independent expert to bear out their views, and he did so, except in one particular, namely, that he was of opinion that it would be better if the supply company's cables were protected in some way when placed in cellars used as store rooms.

Knowing Mr. Broadbent's views on installation matters, we can quite understand his not wishing it to go out that he approved of unenclosed cables. It is always a matter of difficulty to convince a consumer or a contractor of the necessity of enclosing his cables when supply companies' cables alongside are run in the open. If only for the sake of example, it would, we think, be better if supply companies were to systematically carry out the regulations which they lay down for the contractor's work which is connected up to their mains, even although, from the point of view of safety, the same precautions may not be necessary.

COLLIERY EXHIBITION.

As mentioned in our notes in last week's issue, the third Colliery Exhibition held in the Royal Agricultural Hall was opened by Sir Charles MacLaren, M.P., in the unavoidable absence of Mr. Lloyd-George, M.P., on June 12th and closed on Wednesday last. Whatever its two predecessors may have been, there can be no doubt but that on this occasion the Exhibition has been a great success, and great credit is due to Mr. H. Greville Montgomery, M.P., the promoter, under whose personal supervision and organisation the Exhibition was carried out.

In opening the Exhibition, Sir Charles MacLaren, who was supported by Sir Lees Knowles, Bart., and Sir Thomas Wrightson, Bart., congratulated Mr. Montgomery upon the collection of interesting exhibits, which 50 years ago were unknown in colliery engineering; even 25 years ago very few of them were known, and even then they were practically in a rudimentary stage. Long and painful experience in connection with the colliery and engineering trades had taught him that the only way in which coal-owners could make their collieries pay was by keeping down their working costs. Sometimes they hoped to get better selling prices, but there was nothing more illusory than to hope to make anything by keeping prices up; the whole success of colliery working depended upon the working costs being kept down. Not only had the inventions and appliances which they saw around them, done much to reduce the cost of getting the coal, but they also ensured proper and safe conditions for those who worked the coal. Referring to electric power in mines, Sir Charles said that nothing was of more interest to the colliery-owner than appliances which tended to economise motive power, and electricity for haulage, pumping and other applications was now being taken up by colliery managers all over the country. Such an exhibition gave the colliery manager a great advantage in being able to see in a concentrated form all the very latest appliances and improvements, whereas 25 years ago he would have had to spend considerable time in looking up catalogues, making inquiries amongst his friends, and in other ways seeking the best means of carrying out his object, whereas now he could attend the Exhibition, and see practical examples of everything he required. He concluded by expressing the opinion that the Exhibition would be supported by those for whose interest it was promoted.

Sir Thomas Wrightson, in proposing a vote of thanks to Sir Charles MacLaren, remarked that though the coal trade brought forward the locomotive and other inventions, yet the industry was very slow to take up mechanical improvements in general. Coal-owners now, however, recognised that the only way in which to make their collieries a success was by adopting the most up-to-date machinery, and so reducing working costs. He hoped the Exhibition would become an annual event.

Sir Lees Knowles seconded the vote of thanks in a brief speech, after which the company were entertained to luncheon in the dining hall.

As regards the exhibits, these comprised practically every class of colliery machinery used both on the surface and underground, not the least by any means being the number of machines for coal-cutting, hauling, pumping, fans and air-compressing, all driven by electric motors, quite a noticeable feature being the application of three-phase current machines to coal-cutters. Other exhibits included conveying, screening, and crushing plant; boilers, rock drills, models of coal-washing plant, coal tubs, tipplers, steam pumps, safety lamps, and rescue and life-saving apparatus, one firm exhibiting a diving dress and apparatus which might be employed, as they have been on previous occasions, when a mine is accidentally inundated. On the whole, the Exhibition was most interesting, of a representative character, and gave the visitor an excellent opportunity of seeing the great advance which has been made in the design of mining machinery, and gaining some idea as to the mechanical equipment of an up-to-date colliery.

Messrs. Babcock & Wilcox, Ltd., in addition to a model of their well-known water-tube boiler, exhibited a full-size working model of their silent gravity bucket conveyor, which

is specially suitable for handling coal, coke, ashes, ore, &c. The chains are "pushed" by means of the pawls and studs riveted into the links of the chains, on each side of the buckets. The latter are suspended on trunnions, and whether moving in a horizontal or vertical direction will always maintain their proper position. The chain consists of double link chains of flat steel, the steel stud rivets forming distance pieces, upon which the push pawls act, for the pairs of links. The chain wheels, which run upon rails fixed to the framing, are of close grained cast-iron, accurately bored for the axles and they have recesses in the bosses for the reception of a clump of special fibre by which means sufficient oil is retained to supply lubrication for long periods. The oil is supplied automatically by a special apparatus. The buckets are filled by a filler consisting of seven hoods with openings corresponding to the pitch of the buckets, and deliver the exact quantity of material into them without spilling or serious abrasion. The fillers can be supplied either "stationary" or "portable," the latter being suitable when coal is to be retrimmed from storage bunkers to boiler bunkers, or when ashes are collected in quantities at different points. The conveyor is extremely flexible, and the direction may be changed from vertical to horizontal in the same plane, or at any angle to the first plane of motion. As an instance of the cost of handling material with this conveyor, the makers state that in lifting and conveying 40 tons an hour to a height of 40 ft. for 10 hours per day, by a conveyor costing £1,000, the cost works out at less than ½d. per ton, allowing for interest on capital expenditure, attendance, oil, motive power, depreciation and repairs. Other exhibits by this firm included examples of wrought-steel steam piping with wrought flanges; a turbine tube cleaner, a model of an automatic water softener of the Lassen & Hjort type, and a chain grate stoker.

Messrs. Edgar Allen & Co., Ltd., Imperial Steel Works, Sheffield, also had a fine exhibit of conveying and elevating machinery, anthracite breakers, &c. A band conveyor with a throw-off carriage for supplying boiler coal bunkers, was

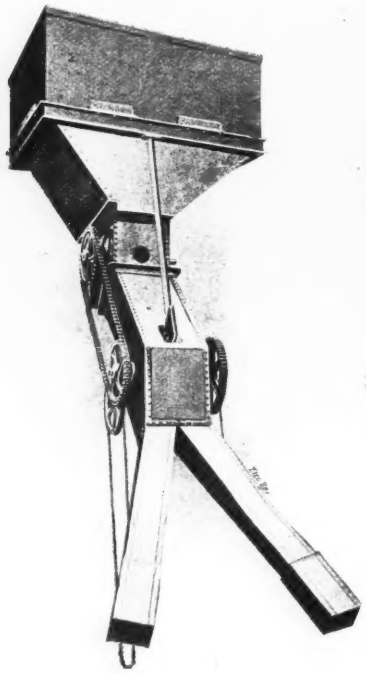


Fig. 1.—Allen's Dust-Proof Automatic Measurer.

specially interesting. Another exhibit consisted of a model of Allen's patent dust-proof automatic measurer, with circular valves so arranged that it is impossible for both to open together, thus securing a correct measure. It is adjustable for varying weights of materials, records each charge, and all gearing is clear of dust. This machine is shown in fig. 1.

Messrs. W. H. Allen, Son & Co., Ltd., showed one of their three-crank three-cylinder compound vertical enclosed quick-speed silent-running engines, fitted with forced lubrication for direct coupling to a dynamo, also a two-crank compound similar engine. Another item consisted of an Allen-Edwards air-pump, each barrel having a diameter of 11 in. × 8 in. stroke, capable of dealing with 20,000 lb. of steam per hour when running at a speed of 150 r.p.m. With this pump, bucket valves are entirely dispensed with head valves only being necessary, and a door at the top of the pump gives access to these, so that the valves may be examined, cleaned and, if necessary, even renewed, without stopping the pump or loss of vacuum or fresh water. Other exhibits included a 5-in. two-stage—or "twin series," as it is termed by the makers—"Conqueror" centrifugal pump, capable of dealing with 500 gallons of water per minute, and a crankshaft taken from one of the firm's three-cylinder compound engines, which, though it has been hard worked for a considerable period, shows practically no signs of wear.

Messrs. Gibbons Brothers, Ltd., Dibdale Works, Dudley, exhibited elevating and conveying machinery, the special feature being a canvas band conveyor at a considerable angle arranged to deliver into a long bunker or hopper. This bunker is provided with the firm's patent push-plate conveyor which merely consists of a plate fixed to a chain carried by flanged rollers supported on rails over the bunker, which, of course, may be divided into compartments. This push plate conveyor scrapes or pushes the coal or other material into one end of the hopper, and as it gradually fills pushes it further along, until gradually the whole bunker is completely loaded. Fig. 2 shows the conveyor as exhibited. Should it be required to shut off any portion of the bunker, this is easily done by covering that portion or compartment by a plate on the framing of the bunker, which allows the coal to be

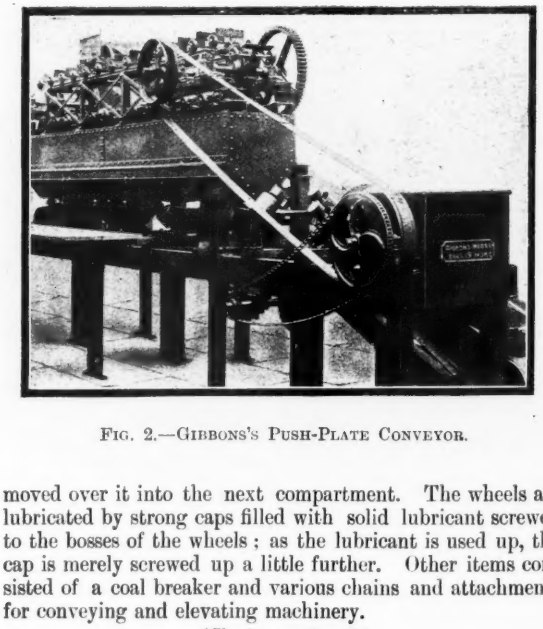


Fig. 2.—Gibbons's Push-Plate Conveyor.

moved over it into the next compartment. The wheels are lubricated by strong caps filled with solid lubricant screwed to the bosses of the wheels; as the lubricant is used up, the cap is merely screwed up a little further. Other items consisted of a coal breaker and various chains and attachments for conveying and elevating machinery.

(To be continued.)

The Electric Smelting of Iron Ores.—Our Toronto correspondent writes:—"As a sequel to the successful experiments the Dominion Government have been conducting in electric smelting of iron ores, the Minister of the Interior has authorised an investigation of the iron ore resources of Canada. The work will be done this summer, and the completed report will treat the economical side of the question rather than the geological. In view of the constant inquiries sent to the Mines Department respecting water power near different iron-ore deposits available for electric smelting, the approximate horse-power of different water-powers met with during the progress of the examination will be ascertained and fully reported upon whenever possible."

THE M.E.A.: A SUGGESTION.

As we go to press, the Incorporated Municipal Electrical Association is holding in London the closing meetings of its annual convention. As this is the eleventh of these gatherings, we may indulge in a little looking backward—generally a profitable occupation, though not always so pleasing as profitable. When the Association was formed, we remarked that it would "probably justify its existence," and we have no hesitation in saying that what was then but a probability is to-day a matter of actual history, for "to bring municipal electrical engineers into relation one with another" was one of its principal objects, and that it has undoubtedly done. We ventured to suggest the widening of the admission gates, so as to obtain the benefit of the valuable knowledge and experience of others who knew much worth telling about the planning and operation of electricity supply systems, but were not *municipal* officials. As years passed on, the wisdom of this proposition was recognised, and there became apparent a disposition to allow certain "outsiders" to take part in the annual deliberations. We have sometimes thought that the gate ought to be thrown still wider open and certain existing barriers broken down so as to remove the exclusively municipal character of the membership with the object of admitting all who are connected with the operation and management of electricity works and power stations by whomsoever owned or controlled. How many men of eminence in central station work there are among us to-day at whose approach the door of this Association would be slammed, men who never put pen to paper, and seldom open their mouths in public institutions in the interchange of ideas. Some of them are men of very lengthy connection with, and ripe experience in, this ever-extending branch of electrical engineering, and they could give wrinkles by the score for the benefit of their younger *confrères* in charge of works of lesser magnitude. We do not need to be told that there are institutions and local sections galore, that in some respects the problems of the municipal and the private enterprise chief and station engineer differ; many other objections of a like kind might easily be advanced. But the number of lighting, tramway and railway power stations has in recent years increased at such a rapid rate that there are in charge of such undertakings to-day a body of chief engineers and assistants that at a guess we should say would probably double or treble the membership of the M.E.A., even including the committee-men. The number of municipal lighting stations is not likely to increase very considerably from year to year, but in regard to railway and other power stations—who shall place a limit to the number of these? Already we have witnessed the birth of a new organisation in the shape of the "Society of Power Company Officials," and we shall assuredly have a further multiplicity of organisations unless it be felt that justification exists for some centralisation of energies. Are not the changes that are taking place an argument for an alteration of the constitution of the association? Is it impracticable to have one comprehensive and coherent organisation in which all may be brought together, say, an "Association of Power and Lighting Station Engineers and Managers?" There would be no secession of leading engineers then as they left municipalities and joined company service.

Are we not at the end of successful negotiations which shall bring together into one amalgamated body the whole of the tramway associations which have far too long had a straggling separate existence? Their objects and aims, their duties and problems, are practically identical; at last this has been recognised, and we venture to foretell a far more successful "run" under the altered conditions.

We are of opinion that what may at first appear to be insurmountable difficulties in the way of municipal and private station engineers combining under one Association roof, may soon dwindle away when engineers for themselves seriously consider that their differences are mainly due to questions of municipal politics with which, *as engineers*, they have, or ought to have, little or no concern. What is the difference between an electrical engineer who runs a station owned municipally, and one who runs some other such plant? As engineers they are confronted with very much the same designing and operating problems. As managers they have both to bring their forces to bear in the direction of commercial development. Here and there a company engineer has to meet the municipal engineer in the same supply area, but is not this more a matter of business competition and price which should hardly be permitted to affect harmonious working in an Association of engineers? Or looked at in another way, might not *some* points of difference lead to both sides of a question being considered fairly instead of too much regard being given to one view only? In the main, both power companies and municipalities have their own particular work to do. They are not so much at war as they once were. Their positions are becoming more clearly and strictly defined. It is only in London at the moment that there is any particular strife, and long after the murmur of this strife has passed away, power station engineers will find it beneficial to meet together, for their difficulties and their new problems are not likely to disappear so long as engineering science strides confidently forward, placing at our disposal new means of obtaining greater economy and higher efficiency in the construction and working of power stations, distribution and transmission systems, and so forth.

At this week's meetings of the M.E.A. there have been no papers read by committee-men. This is a step in the right direction; it is a step toward making the body an electrical association, with the word "municipal" and its consequent limitations cut out.

As we have said, the M.E.A. has served its purpose and justified its existence in its first 10 years, and we have no desire whatever to begrudge those who had a part in its establishment whatever credit may have belonged to them in that connection. But we cannot let all their claims pass unnoticed. Like many of our readers we find it very useful to have our old volumes of the ELECTRICAL REVIEW at hand to refresh our memory when we indulge in retrospection. May we then quote from our issue of March 6th, 1896, page 295? We said:—

"The formation of the Municipal Electrical Association was suggested by Mr. John H. Rider to a meeting of municipal electrical engineers held in Westminster in July last, to discuss the new Board of Trade rules, and was very warmly supported."

Let honour be given where it is due—even though it be 10 years after the event!

OPENING OF THE SOUTHWICK POWER STATION OF THE BRIGHTON CORPORATION.

ON Saturday last the new power station of the Brighton Corporation electricity department was formally opened by Mr. John Burns, M.P., President of the Local Government Board, the opening ceremony being preceded by a luncheon at the Royal Pavilion, where, although he fortunately missed the luncheon—Mr. Burns was able to supply the *pièce de résistance*.

In responding to the toast of his health, proposed by the Mayor (who incidentally referred to his guest as the Hon. Robt. Burns), he ascribed his presence there to the result of peaceful picketing or intimidation, and proceeded to outline the extensive work undertaken by the department of which he is the official head. He eulogised the municipal government of England, which, if it resulted in high rates, provided many corresponding public benefits in return; and—absent-mindedly we suppose—alluded to "the Oriental submission and ox-like subjection" of the ratepayers of 40 years ago, who, we may remark, have, curiously enough, a remarkable counterpart in a prominent community indebted in more ways than one to Mr. Burns and his friends at the present time.

After the luncheon the party proceeded to Southwick, some 4 miles distant, where the chairman of the Lighting Committee, Councillor Butt Thompson, briefly recalled the progress of the undertaking during the 14 years which it has been established.

Mr. Burns subsequently declared the new building open, referring in the course of his speech to the subject of

municipal account keeping, in connection with which he remarked that the Departmental Committee he had recently appointed to go into the question, would draw up such a form of accounts "that he who runs may read;" he further urged Brightonians to consider a policy of reduction in charges for energy, of extension of tramways, and quite appropriately expressed his marked preference for electricity as opposed to gas.

The Southwick Works have been carried out under the Brighton Corporation Act, 1900, and at a cost of about £350,000.

The buildings, which are situated on a strip of land lying between the sea and Shoreham Harbour, will hold some 16,200 KW. of plant, only one-third of which has so far been installed.

The structure consists of a main engine room 73 ft. × 222 ft., with boiler houses on either side; there are also battery rooms, offices, stores, &c. In the east boiler house, which is in working order, there are installed two banks of boilers arranged in a single row. Each bank consists of three Babcock & Wilcox boilers, of 20,000-25,000 lb. evaporative capacity and working at 200 lb. per sq. in. pressure, together with a separately fired superheater and a 480-tube Green economiser. A single steel chimney, 100 ft. high, 6 ft. in diameter and lined with firebrick to the top, serves the boilers already erected, being placed centrally and worked in conjunction with an induced draught plant. A coal bunker of 1,500-2,000 tons capacity is provided to each boiler house; the coal-handling plant at present installed was supplied by the Pirrie Transporter Co., and will deal with 30 tons of coal per hour. The coal is drawn from colliers, which can moor in the harbour alongside the boiler house, and is lifted up in 1-ton skips, automatically weighed on an integrating weighing machine of Dennison's make, and tipped into a hopper, from which it falls on to a belt conveyor for distribution by means of a self-trimming carriage into the bunkers. From the latter, fuel is fed into the hoppers of chain grate stokers, which are fitted to both boilers and superheaters, by means of three Ingrey travelling coal-weighing and filling machines; the ashes from the furnaces are dealt with by means of trucks in the boiler house basement.

Feed storage tanks of 100,000 gallons capacity, and a Reisart water softener with a capacity of 1,000 gallons per hour for treating the make up from the town mains, are situated on the roof above the boilers; two Hall compound steam pumps situated between the two banks of boilers and supplemented by an injector on each boiler, are provided for boiler-feed purposes. Altogether there is space for 18 boilers and six superheaters in the boiler buildings, the equipment of which is of more than ordinary interest in these days of prosaic design.

The engine room, although containing typical examples of modern plant, does not present any particular novelty. Three 3,000-B.H.P. Westinghouse turbo-alternators of the well-known pattern, are at present installed, the alternators being of the three phase revolving field type, of 1,800-KW. capacity, each generating at 8,000 volts pressure and 50 cycles, with a small 75 KW. exciter coupled to the extremity of the alternator shaft.

Each turbine is provided with a vertical surface condenser of 5,800 sq. ft. area, together with electrically-driven circulating, dry air and three stage centrifugal hotwell pumps, installed in the basement immediately below each unit. The circulating water is obtained from and returned to the adjacent harbour through 60 in. dia. suction and discharge pipes. The usual turbine lubrication system adopted by the Westinghouse Co. is provided. Space is available for six more similar units in the engine-room, which is spanned by a 20-ton electric travelling crane; the units have a guaranteed overload capacity of 33 per cent. for one hour.

For operating the auxiliary machinery, oil switches, &c., assisting in the excitation, supplying the station lighting and the Aldrington district of Hove in bulk, there are installed in the engine room two 220-KW. Willans-Siemens D.C. units, brought from the North Road Works, one 400-H.P. induction motor-generator and a 1,000 ampere-hour Chloride battery and reversible booster.

The high tension switchgear for operating the turbo-units is of the Westinghouse Co.'s remote controlled type, and is installed at one end of the building. The operating switchgear occupies a gallery, as usual. The oil switches are arranged at one end of the engine room floor, where also a direct-current switchboard of the British Thomson-Houston Co.'s make, for operating the auxiliary plant and the Aldrington supply, has been installed. Communication between the switchboard and the turbines and boiler plant is facilitated by Chadburn's mechanical telegraphs (of ship pattern), and from the Southwick Works to North Road sub-station by a Graham loud-speaking naval telephone.

The H.T. switchgear controls five three-core trunk feeders, supplied and laid by Messrs. Siemens Bros. & Co., Ltd.; these cross the harbour and run a distance of $4\frac{3}{4}$ miles to the Old North Road generating station, where a large sub-station has been erected as an annexe. The sub-station equipment was supplied by the British Westinghouse Co., and is of their standard type; it includes two 1,500-KW. rotaries, each coupled to a bank of three transformers with an inductor regulator for the 230-volt supply, also four 500-KW. induction motor-generators for 230, 460 and 550-volt supply, together with the necessary switchgear. The sub-station can be operated separately or in parallel with the steam plant in the old station, the same L.T. feeder board being common to either source of supply.

At the present time some 4,500 consumers with 300,000 lamps are supplied by the department, which sold 8,000,000 units during 1905, and is financially in a good position, having placed to reserve some £28,880 and contributed to the rates £14,224.

Mr. John Christie is the engineer and manager, and Mr. Arthur Wright, whose lengthy connection with Brighton is well known to our readers, is the consulting engineer to the department.

THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

THE eleventh annual Convention of this Association was opened at Kingston-upon-Thames on Tuesday morning last, in the Royal County Theatre. A large muster of members and friends, accompanied by a goodly gathering of fair ladies, left Waterloo by the 9.47 train, and on reaching Kingston they were cordially welcomed by the Mayor of that ancient borough, Councillor H. J. Minnitt, in a few words. The Deputy-Mayor, Mr. Alderman Collins, also addressed the assembly, and congratulated Mr. J. E. Edgcome, this year's President of the Association, on the position he had acquired. Mr. Edgcome having expressed his thanks, announced that Mr. Trotter (Electrical Standards Laboratory, Board of Trade), the Robertson Electric Lamp Co., and the B.T.-H. Co., Rugby, had extended invitations to members during the convention. He then proceeded to read his presidential address, an abstract of which we give on another page. After Councillor Francis, chairman of the Lighting Committee, had proposed that a hearty vote of thanks should be offered to Mr. Edgcome, Mr. Sydney Baynes was called upon to read his paper, entitled "Steam Turbines" (illustrated with lantern slides). Mr. Baynes, however, did not read his paper, but he gave us a lantern-slide tableau in three scenes, A_1, B_1, and C_1, but he was not A_1. The animated photographs at last year's Naval Exhibition were not to be spoken of in the same breath, and Mr. Baynes, as scene shifter, was as amusing as a character in a comic opera, but this was only right in a theatre. We unluckily occupied a seat under the private boxes, so that when the desultory discussion commenced from boxes, stalls, dress circle, &c., on what was not clear to anybody who had not had the chance of previously reading the paper, we failed to catch the words of wisdom which fell from the lips of Messrs. Fedden, Long, Fox, Izzard, Proctor, Bowden, Samuelson, Taite and others.

One could occasionally hear of the stripping of blades, opinions expressed as to whether stator and rotor became uniformly heated, whether the turbine should be warmed up for an hour before running, whether water should be drained off, steam turned on, and running immediately started, so that all parts became uniformly warm as working went on.

Some commotion was caused by Mr. Izzard's "Why worry about blade stripping?" And during the pause which followed we distinctly heard a frivolous member exclaim *sotto voce*: "Are we downhearted?" Was not the success of the turbine in a given period greater than had ever fallen to the lot of the reciprocating engine, had not greater numbers been made and sold, and what, after all, was there to make a fuss about in blade stripping? Economy in steam left an ample margin for the cost of stripping repairs. Mr. Faraday Proctor went on in the same strain, and instanced a turbine running for 10 days before it was found out that stripping had taken place.

Baillie Willock, of Glasgow, who was pleased to term himself a Common or garden Councillor, turned aside from technicalities, and told us that what was wanted in the face of fierce competition from gas is a cheaper method of generating electric current. Which is the more economical, roared the Councillor, the turbine or the reciprocating engine? In Glasgow they had four large engines, erected on the advice of an American, and which cost £102,000. Two of these were of 9,000 H.P., and recently they had purchased two Willans turbines of the same horse-power for £30,000. The worthy Councillor got so heated and vehement that he made use of an expletive which brought an expression of utter blankness on the countenances of the ladies; a word we dare not print but which, we understood, was not considered good Scotch in polite society.

Mr. Baynes, in a brief reply, told us that his experience of stripping was in direct conflict with that of Mr. Proctor. They knew at his station of a slight stripping in a turbine, but decided to let it go on running, with the result that a complete stripping and entire breakdown took place. We sum up the paper in another column.

The rest of the day was devoted to luncheon, pleasure trips on the river, a visit to Hampton Court Palace, and the ordeal of facing the camera of the gay photographer, social amenities which, alas! were denied to us by the more serious calls of a strenuous life.

PARK ROYAL POWER STATION AND THE HAMMERSMITH AND CITY ELECTRIC RAILWAY.

The new generating station of the Great Western Railway Co. is placed at Park Royal, beside their new line to High Wycombe. A siding from this line is carried to the station for the delivery of the plant and coal, and removal of ashes. The present station only occupies about one-sixth of the ground available, and it is so designed and placed on the site as to enable five other similar stations to be added as the demand for power increases.

The electrical power is generated as three-phase current at from 6,300 to 6,600 volts pressure and 50 periods. It is transmitted from Park Royal by six H.T. three-core, paper-insulated, lead-covered and armoured cables laid underground on the solid system. These cables run from Park Royal beside the railway line to Old Oak Common, where the first sub-station is built at the junction between the High Wycombe line and the Great Western main line.

From the Old Oak Common sub-station five H.T. main feeders are carried beside the main line to Westbourne Park, where they branch in a special inspection chamber, four feeders going to a sub-station on the south side of the main line at Royal Oak, and three going to a sub-station on the west side of the Hammersmith and City line near Shepherd's Bush.

The distance from Park Royal to Old Oak Common is about 1 mile, to Royal Oak about 4¼ miles, and to Shepherd's Bush about 5 miles.

In the sub-stations, the greater part of the three-phase current is transformed down by motor-generators from 6,600 volts to 630 volts direct current. At this pressure it is distributed from the Royal Oak and Shepherd's Bush sub-stations by concentric lead-covered cables to the conductor rails of the Hammersmith and City Railway. At Old Oak Common and at Royal Oak the direct current at 630 volts is also distributed for lighting the locomotive and carriage sheds, goods yards and offices, and part of Paddington Station.

A certain part of the three-phase supply to each sub-station is again distributed at the full pressure of 6,600 volts to distributing centres, of which there are 11 in all, where it is transformed down by static transformers to either 220 or 110 volts. At this pressure the alternating current is used for arc and incandescent lighting and small motor work throughout the Great Western Railway Co.'s stations, goods yards, offices and hotel at or near Paddington and on the Hammersmith and City railway.

We shall refer to the power station and sub-station equipment later in this article.

The lines which have been electrified, and which obtain power from the Park Royal generating station, include the Hammersmith and City line proper, the Great Western additional lines between Bishop's Road and Westbourne Park, and the branch line from Latimer Road to Uxbridge Road. From Uxbridge Road to Addison Road the trains run over the West London line, a portion of which has, in consequence, had to be electrified, together with two bays at Addison Road station.

The system adopted had to be the same as that already in use on the Metropolitan and District Railways, as the Hammersmith and City trains run over the Metropolitan Co.'s lines from Bishop's Road by the Inner Circle to Aldgate. There are two insulated conductor rails, the positions of which correspond exactly with those adopted on the Metropolitan and District Lines, the positive being 3 in. above rail level and 16 in. outside the running rail, and the negative conductor being 1½ in. above rail level, and in the centre of the track. The two conductor rails are of an inverted channel section and rest on iron-capped porcelain insulators. The insulator is fixed to the sleeper by small clamps and coach-screws. This design leaves the conductor rail and insulator free to move up and down relatively to each other, as occurs when a train is passing owing to the spring in the sleepers and road bed. The rails weigh 102·8 lb. per yard, and have a cross-sectional area of approximately 10 sq. in. They are made of a special quality of steel having a conductivity equal to 15 per cent. of that of copper. The rails are fished by a joint plate bolted on the underside, and are connected by four laminated copper strip bonds which are practically protected by the joint plate. Long steel ramps made from a bent section of the ordinary conductor rail are used at all facing ends, and short cast-iron ramps at trailing ends. At points and crossings the different lengths of conductor rail are connected together by rubber insulated and lead-sheathed armoured cables buried direct in the ground, each end of the cable being sealed in a specially-designed porcelain terminal cap from which a solid copper rod projects. To this projection two flexible copper bonds are clamped, the other ends of the bonds being expanded into the conductor rail. Any jumper cable can be in this way at once disconnected by the removal of two bolts in the clamp. The feeder cables are connected to the rails in the same way.

The conductor rails are divided into the sections corresponding approximately to the distance between the stations. A section insulator is placed just beyond the cross-over at each railway station, so that in the event of a breakdown at any point it would always be possible to continue working the trains up to the next station, by using the cross-over there for shunting the trains from one line to the other. Under normal conditions all sections will be connected together, the gap at the section insulators being bridged by switches which will be kept closed.

The line is fed from the sub-stations at Shepherd's Bush and Royal Oak, eight feeders being carried from the former, and four from the latter.

Large new train sheds have been built at Hammersmith to house the whole of the 20 electric trains being built for this line. The ordinary conductor rails are stopped 15 ft. away from the shed doors so as to leave a clear gangway outside the sheds. Inside the sheds the trains will be supplied with current from overhead. A steel joist carrying a small trolley is supported from the roof principals above each line from end to end of the carriage shed. The trolley is fitted with two collectors which take current from two insulated

trolley wires placed one on each side of the steel joist. A flexible cable from the trolley can be plugged on to a socket in the train.

Inspection pits are provided throughout the car-shed for the examination and overhauling of the trains, and in addition a repair shop is built at one side fitted with an electric crane and machine tools for carrying out all necessary repairs and renewals.

Twenty trains are being built for the Hammersmith and City Railway by the Metropolitan Amalgamated Carriage and Wagon Co., at Saltley. Each train consists of two motor-cars and four trailer cars, and has a total seating capacity of 320. The cars are similar to the Metropolitan Co.'s cars with closed vestibules.

The whole of the electrical equipment of the trains is being supplied and fitted by the British Thomson-Houston Co., the greater part of the switchgear and motors being built at Rugby. Each motor-car is fitted with four 150-H.P. motors, two on each bogie. They are designed for a schedule speed of 16 miles per hour including stops, and for a maximum speed of 30 miles per hour.

The control is on the multiple unit system with the B.T.-H. electrically-operated contactors, each pair of motors being operated separately in series-parallel. One end of each motor-car is partitioned off to form a driver's cab, and is fitted with a master controller and Westinghouse and hand brakes in addition to the usual switchboards. Provision is made for fitting master controllers at other points throughout the train, should it be decided to split the trains for part of the day, and so make it necessary to drive from a trailer platform. The whole of the contactors, the reverser, and motor-driven air compressor are placed beneath the motor-car floor, so arranged that they can be examined from beside the track. All connecting leads are run in metal pipes, and special precautions have been taken elsewhere to prevent the spread of fire.

The trains are fitted throughout with the Westinghouse compressed air brake, and are also electrically lighted and heated.

The rolling stock was constructed to a specification prepared by Mr. G. J. Churchward, locomotive superintendent to the Great Western Railway, and Mr. Alfred Ingram, carriage and wagon superintendent to the Metropolitan Railway Co. The electrical equipment of the trains was carried out to a specification prepared by Messrs. Kennedy & Jenkin, as consulting engineers to the Great Western Railway Co., and Mr. Thomas Parker, acting as consulting engineer to the Metropolitan Railway Co.

The car-shed has been provided, and the permanent way equipped, under the supervision of Mr. W. W. Grierson, the company's engineer. The electrical equipment of the line and of the train sheds was also carried out to specifications prepared by Messrs. Kennedy & Jenkin.

The laying, bonding and jointing of conductor rails was done by the Great Western Railway Co., the material being supplied as follows:—

Conductor rails and joint plates ...	Frodingham Co.
Insulating supports	Messrs. Doulton.
Jumper cables	Messrs. Henley.
Copper bonds	Forest City Co. as sub-contractors to Messrs. Henley.

The contract for the equipment of the train sheds was given to Messrs. Blackwell & Co.

The Power Station.—The main engine room at Park Royal is built in three bays. Four 750-KW. three-phase generators and engines are placed in line in each outer bay, making altogether a total capacity of 6,000 KW.

The three-phase generators were built by the Electric Construction Co., and are of the ordinary rotating field type, star connected, but the centre point is not permanently earthed. They have an overload capacity of 25 per cent. for one hour. The armatures can be slid sideways for inspection or repair. Each generator is direct coupled to a Belliss & Morcom triple-expansion side-by-side engine which runs at 250 r.p.m. The governor of each engine is controlled by an electric motor from the switchboard gallery, for adjusting the load between sets running in parallel. An electrically controlled emergency switch is also fitted to each engine, so that, if desired, steam could be entirely cut off by the switchboard attendant.

The excitation current for the main three-phase generators is obtained from two auxiliary sets and two batteries. One of these exciters is steam driven and the other is motor-driven. The exciter generators are exactly similar machines, each of 150-KW. output at 220 volts. The auxiliary engine is of Belliss & Morcom's make, compound with two cranks and runs at 428 r.p.m. The motor driving the second exciter set is a three-phase induction motor designed for the full H.T. pressure of 6,600 volts.

The batteries which form a stand-by for the excitation supply are worked in parallel with the exciter generators in the usual way, with motor-driven boosters for charging them from the bus-bars. Each exciter generator with its battery can be worked by itself, and used for exciting any or all of the main generators when required. There is, therefore, a complete stand-by generator and battery for the excitation supply.

In addition to the two exciter generator sets, there are two auxiliary three-phase generators of 150-KW. output, one steam driven and the other motor driven. The two generators are alike, and generate three-phase current at 630 to 660 volts. The steam engine is a duplicate of that driving the exciter set described above, but the motor driving the second three-phase auxiliary generator is a direct current motor, taking its supply from one of the exciter switchboards.

The auxiliary three-phase supply at 630 volts is used principally for driving the various motors throughout the generating station, such as the circulating pumps for the condensers, the automatic stokers on the boilers, the coal conveyers, &c. A three-phase switchboard for the auxiliary supply is placed on the switchboard gallery between the two main high tension switchboards mentioned below. Two sets of step-down transformers are provided by which all the auxiliary three-phase plant can be driven when necessary from the main high tension supply without running any of the auxiliary sets.

The motor-driven three-phase generator can be used when required for charging feeders, or it can be run backwards taking current through the transformers from the H.T. supply, or direct from the auxiliary supply, and delivering D.C. current to the exciter switchboard.

There are two main H.T. three-phase switchboards, one at the west end of each main engine room bay. The two boards can be worked independently of each other, or can have their bus-bars connected for working in parallel. Each board has a duplicate set of main bus-bars and also H.T. synchronising bus-bars, which are used for testing and charging the feeders as well as for synchronising the generators. Any generator or feeder can be connected to either set of main bus-bars. A somewhat novel arrangement of making these connections has been adopted. The circuit from each main generator and each feeder is branched and connected to two oil-break automatic switches. Each automatic switch is directly connected to one set of the main bus-bars. By this arrangement the two automatic switches are used also as selector switches, and are also a stand-by to each other. The machines can be changed from one set of bus-bars to the other through the machines own switches, or through a separate bar-coupling switch. In order to avoid any mistake in synchronising with the wrong set of bus-bars when switching in a generator, a system of mechanical interlocks is fitted at the back of the control panels. This arrangement was proposed by the British Thomson-Houston Co., who have supplied all the switchboards at the generating station.

The high-tension part of the board extends from the basement to a total height of 33 ft., and consists of a steel framework filled in with stone slabs. Each circuit runs from the bottom to the top of the board, and is separated from the rest by vertical stone partitions. The switches, transformers, &c., of each circuit are further separated from each other by four horizontal partitions which divide the whole structure into a set of fireproof cells. Iron doors are fitted to the back of the cells, giving access for inspection and cleaning.

The control board is placed on a gallery about 14 ft. above the engine room floor, and slightly in front of the H.T.

switchboard proper. The main switches are worked from the control panels mechanically by rods and cranks. All the instruments are placed on the control panels, and are worked off transformers, so that all connections on these panels are low tension.

Immediately in front of the control panels are placed the main generator field regulating resistance columns, and also a set of signal columns and indicators by which the switchboard hand can communicate with the driver of the engine.

At the end of the centre bay of the engine room, the auxiliary three-phase board, working at 650 volts, is placed on the same gallery as the main switchboard control panels. This auxiliary board is also fitted with two sets of bus-bars, and is connected through step-up transformers with each of the main H.T. boards. The supply is, however, normally obtained from the two three-phase auxiliary generators described above. Feeders are taken from this board to the various three-phase motors throughout the power house.

Two direct-current exciter boards working at 220 volts are provided, one at the end of each of the main engine room bays. These are placed at the floor level immediately under the front of the main switchboard gallery. The two exciter boards can be worked separately or in parallel, and each is connected to an auxiliary D.C. generator, and to a storage battery. The supply for the excitation of the main and auxiliary three-phase generators is taken from these boards, as well as for working the D.C. crane motors, and the arc and incandescent lighting of the power house.

The main steam pipes between the boilers and generating plant are arranged on the duplicate system in the boiler house, and on the ring system in the engine room. Each boiler is connected to two lines of steam pipe carried down the sides of the boiler house. These two lines are connected across the end of the boiler house above the pump room. The ring in the engine room is teed off the double line in the boiler house through the necessary valves, and is itself divided into sections by valves between the branch pipes to the several engines. The whole of the steam pipes are made from solid-drawn steel tubes. The usual auxiliary, drain and other pipes are provided, and do not call for special mention. This section of the work was carried out by Messrs. Aiton & Co.

The condensing plant is placed in the centre bay of the engine room, and consists of four surface condensers with their air pumps and circulating pumps, the main engines being connected in pairs to each condenser. The condensers and steam-driven air pumps were built by Messrs. Belliss and Morcom, the air pumps being of the Edwards type. A small force pump is also driven by each air pump engine for raising the condensed water to the filtering plant mentioned below. The circulating pumps are of the centrifugal type, each driven by a 65-H.P. three-phase motor worked from the auxiliary supply at 650 volts. The circulating water is brought by four pipes, run in the basement under the centre bay, to the pump suctions, and after passing through the condensers rises vertically to a gallery over the centre bay, 30 ft. above the floor level. The water passes back by two pipes along the gallery and out at the west end of the engine room to a set of four Klein cooling towers among which it is distributed by pipes and troughs in the usual way. The water is collected in large concrete tanks below the towers, from which it is drawn again by the circulating pump suctions.

The use of surface condensers makes it necessary to remove all oil from the condensed water before it is returned to the boilers. For this purpose a large oil separator is placed in the exhaust pipe between each engine and its condenser. From the bottom of this separator the oil falls by gravity to a small steam-driven force pump, by which it is pumped to settling tanks in the basement. After the condensed water has passed through the air pumps it is lifted by the force pumps, driven by the same engines as the air pumps, to the filtering plant which is placed at the west end of the boiler house. This plant is arranged in two units, which together are capable of dealing with the whole of the water from the engines when required. The filtering plant was built by Messrs. Davis-Perrett, Ltd., and is of their electrolytic type. The direct current required is taken from the lighting supply. From the filters the clean water falls by gravity into two large hot-well tanks placed in the basement under the feed pump room in the boiler house.

The make-up feed water is treated in a softening plant of the Paterson Engineering Co.'s make. This plant is supplied in duplicate to facilitate overhauling and cleaning. After treatment the water falls by gravity into the two large hot-well tanks mentioned above.

(*To be concluded.*)

STEAM TURBINES.

Mr. S. W. Baynes's paper on steam turbines read before the Municipal Electrical Association really contains little or nothing novel. Yet it is a good paper, for its author has condensed into a small space the main facts relative to the construction of the several principal forms of steam turbine and the various differences that have been introduced into the Parsons turbine by other makers, such as the Brush Co. and Willans & Robinson. No attempt is made to give a theoretical disquisition of the action of the steam in turbines nor of the peculiar reactions which may arise from the methods of governing. Parsons employs the gust system of governing, for example, whereas Willans & Robinson employ what, to us, appears a more rational system of throttling the steam initially, thus avoiding the rapid changes in temperature inside the turbine that must necessarily follow upon the gust system.

The Curtis turbine has something of a resemblance to the Girard water-wheel, in that admission of the working fluid only takes place upon a fraction of the circumference, and it becomes, therefore, very easy to govern this wheel by a sliding gate, which shuts off one opening at a time of the nozzles through which the steam first enters. So far as one can gather, there does not appear to be very much difference between the performances of different turbines, though if there is sound basis to the kinetic theory of gases, those turbines ought to do best economically, which employ the impulse of the steam. The difficulty, of course, is that no wheel can be run at the proper impulse velocity.

The Brush-Parsons turbine has a very ingenious water seal to prevent infiltration of air into the vacuum. A revolving chamber contains water into which a dip ring enters, and the centrifugal effect of a comparatively shallow dip of water is sufficient to prevent the seal being blown by the outside atmospheric pressure. Every type of turbine has its own advantages and ingenuities, such as the water seal of the Brush machine, the balancing pistons of the Parsons machine, and the ingenious water pressure foot disk of the vertical Curtis wheel. The latter turbine also aims at a better and sounder mechanical construction than any other type, for its blades are cut by special machinery out of solid steel disks, and there is no tamping in of blades, which some engineers object to as savouring somewhat of tinkering. Yet the great Cunarders are to have tamped-in blades, so that they are accepted by a great firm of marine builders.

The Rateau turbine is built up of disked steel plates riveted together and to a steel sleeve boss, and the blades are riveted to the edge of one of the disks, which is turned over to form a rim of channel form for that purpose. The blades are of nickel steel pressed to form and ground to a fine edge. There is a set of fixed blades between each disk, carried on a diaphragm which comes close down to the central shaft, on which the rotor disks are fixed. Only at this point can any leakage take place. The Rateau is thus an impulse, or a series of impulse wheels, with an open chamber after each pair, unlike the Parsons, which has a continuous rotor and a numerous succession of fixed and moving blades with no space for any lingering of the steam in its course.

The governor gear is apparently that used many years ago on the McNaught piston valve gear for varying automatically the radial twist of the valve for cut-off movement. In this case the gear acts, however, on a double-beat valve, which is opened or closed as required. The governor merely

moves a detent piece: it does not transmit force, and will, therefore, act sensitively.

It is noted that makers of turbines do not agree as to how a turbine should be warmed up. One firm says, warm gradually by passing steam through the wheel until it is equally warm throughout, the rotor not moving. Another maker says, let the machine run at once, and it will warm up equally, which seems rational, for the very movement of the blades must equally distribute heat throughout the whole interior spaces. Six turbines in all are described—the Parsons in three modifications, the Westinghouse, which also is a form of Parsons wheel, the Curtis, the Rateau, the Zoelly and the De Laval—and the paper should be useful as a general first index to the turbine for any engineer who contemplates its adoption.

INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

Abstract of Presidential Address by Mr. J. E. Edgcome, Chief Electrical Engineer, Kingston-upon-Thames.

I have decided to practically limit my remarks to matters concerning our own Association, but propose to deal to some slight extent with one matter which may, perhaps, be regarded as a distinctly debatable question. I refer to municipal trading; and although I do not propose to set forth here any opinion as to the merits or demerits of municipal trading as a whole, still, there is one phase of this question which, I think, may be touched upon with some advantage in this address, and that is the question of municipal wiring of consumers' premises.

I would suggest that local authorities having entered into an agreement with new consumers to enable them to spread the cost of the work over a number of years on the basis of a deferred payment system, and having ascertained the requirements of such consumers, should prepare a specification of the work required, and, instead of then proceeding to carry out the work, should obtain tenders from suitable contractors, and having supervised the carrying out of such work, should be prepared to make the necessary payments to the contractor on the completion of the work.

This arrangement is obviously to the advantage of the consumer, as he is enabled to spread the cost of the installation over a period of years. He knows that his work has been carried out to a satisfactory specification, under proper supervision and probably at a lower cost than would otherwise be the case, as obviously no extra sum on account of risk of bad debts need be included in the contractor's tender to the municipality for the work to be carried out on the consumer's behalf; whilst, on the other hand, the contractor would have no reason to complain that the municipality were entering into direct competition with him, as might be the case if the staff of the local authorities were to carry out the work.

I feel assured that if local authorities decided in all cases to carry out their schemes of assisted wiring on these lines, contractors would soon cease to complain of what they now allege is the unfairness of municipal trading, and, on the other hand, would welcome such a scheme as a means of promoting the growth of electrical work throughout the country.

I propose now dealing entirely with matters affecting this Association.

Although, owing to our constitution the field from which we can gather our members is a somewhat limited one, and although many of the larger towns owning municipal electricity undertakings have already joined the Association, it is still open to us to further increase the number of our members, seeing that there are at the present time about 258 local authorities owning electrical undertakings in operation in the United Kingdom, exclusive of electrical undertakings owned by local authorities in the Colonies who are also eligible for membership, and we are glad to number among our members some of these Colonial engineers and committees.

There are, I believe, about 800 assistant engineers who are eligible for election as associates, but of these we at the present time number among our members only 61. It is therefore evident that the assistant engineers in municipal electrical undertakings do not as a body consider that sufficient inducements have hitherto been held out to them to join the Association, and the Council, recognising this fact, have very carefully considered the matter and decided upon a course of action calculated to overcome this difficulty, and to which I will refer briefly.

It was apparent to the Council that, in the majority of cases, the assistant engineers were unable to attend the annual conventions during the absence of the chief engineers, who were themselves attending the meetings, and as difficulties had arisen in carrying out the suggestion of holding a second convention annually for Associate Members and Associates, the Council were compelled to consider other matters likely to prove of advantage to the class of members whom they wished to encourage. It was decided to reduce the amount of the annual subscription for associates, and also to suggest to the Association the promotion of a scheme which should prove an inducement to assistant engineers to join the Association and to send in papers upon subjects connected with their profession.

There has always been some difficulty in obtaining from Associates papers of general interest, and the Council, with a view to stimulating a desire on the part of assistant engineers to write such papers, propose to offer for competition each year one or more travelling studentships which will enable the holder to visit various works throughout the kingdom; and the Council hope that the assistant engineers of the various municipal stations will appreciate these efforts on their behalf, and will be prepared to co-operate with them.

Although it will be seen that there is still a possibility of extending our membership, yet this can only be done to a limited extent; whereas, on the other hand, there is no such limit to the useful work which this Association can do, and it is upon this question of the sphere of usefulness, which I think lies before it, that I propose to dwell.

I am sure it is fully recognised that this and other kindred associations have done and are doing useful work in the interests of engineering generally; but, in my opinion, some of the greatest benefits obtained by members of such associations are those resulting from a constant interchange of ideas between members, and certainly the chief factors in promoting this interchange of ideas are the conventions which are held annually by associations in various towns.

A noticeable feature of these conventions is the fact that members are at all times not only ready, but anxious, to give one another the benefit of any experience which they may have obtained in the course of their work.

The attendance at these conventions of the chief engineers and the representatives of committees results, of course, in a certain amount of expenditure to the local authorities, and it has been sometimes suggested that this expenditure of public money is an unnecessary one, seeing that copies of the papers read and of the discussions upon them can be obtained for a nominal sum. Personally, however, I cannot agree with this suggestion, and I am sure that those members of committees who have attended the conventions of the Association will readily agree that the valuable experience obtained by attendance at these gatherings far outweighs the comparatively small cost incurred.

Unfortunately there is a tendency on the part of the Government authorities to disallow, in certain instances, the payment of expenses incurred by the representatives of local authorities and their engineers when attending these conventions. I certainly fail to understand on what grounds this expenditure should be disallowed, seeing that although the experience gained by the engineers and members of the committees is an experience which is useful to them individually, it cannot be gainsaid that it must be of still greater value to the authorities which they represent and to the undertaking which they control, and I trust that in due course this may be fully recognised.

I have dealt very briefly with some of the work which the Association is doing, and I now propose to deal somewhat more fully with a work which, in my opinion, the Association can usefully carry on. As you are all only too well aware, it is a habit among electrical engineers to send out inquiries from time to time to one another in respect to the many and varied matters relating to the generation and distribution of electricity.

Unfortunately the majority of station engineers find their time fully occupied with other work; and although they invariably respond cheerfully to these too frequent calls made upon their time, still they cannot but have a feeling of regret that the available data collected in this manner throughout the country is not tabulated for future reference, and I certainly think that this is work which lies clearly within the scope of our Association, but which can only be satisfactorily carried out by means of a central bureau.

There are, of course, many difficulties in the way of its successful inception; still, I am sure that engineers as a body will readily agree that difficulties exist only to be overcome.

If the majority of the members of the Association consider that such an institution would be of benefit to the Association, there should be no difficulty in carrying their wishes into effect.

I need hardly point out that for some years the collection of the requisite information will be a considerable tax upon the time and good nature of the members of the Association; but they will doubtless appreciate the fact that the work which they are called upon to do in giving information to the Bureau will be work of an exceedingly useful and lasting character, from which permanent records will be made, and they will feel that the result of their labours is being collected for the general use of the members, instead of being, as in most cases at present, put aside after it has served the temporary purpose for which it was collected, and they will realise that in a few years they will be able, upon receipt of a budget of inquiries, to refer the applicant to the central establishment, which will then be fully qualified to deal with the matter.

The central bureau might also be used as a meeting place for the members when in London, and a comprehensive technical reference library should be considered as a likely feature of the scheme.

It might also be thought advisable to arrange for the keeping of a register of assistant engineers, so that chief engineers could make inquiries at the bureau when desirous of filling vacancies on their staff.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Single-Phase Induction Motor.

I have read with interest the letter contributed by Mr. Pensabene-Perez, and I see he agrees with me that the no-load current of a single-phase shunt induction motor, devoid of losses and leakages, is equal to the magnetising current, but he thinks that this only holds good if the motor is provided with a rotor short-circuited by means of two sets of brushes along axes displaced by $\frac{180}{n}$ or 90 electrical degrees.

According to Mr. Pensabene-Perez, this form of shunt induction motor is very different from the ordinary—for instance, from the squirrel-cage shunt induction motor. I will, first of all, attempt to show that the two forms are identical in their behaviour.

Taking the motor shown in fig. 6, we can obviously replace the rotor winding short-circuited along the axis C C

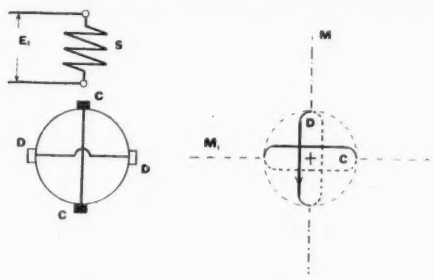


Fig. 6. Fig. 7.

by a single coil such as C, and disposed as shown in fig. 7; we can also replace the rotor winding short-circuited along the axis D D by a single coil such as D. Let these two coils be, for instance, independently short-circuited, let them revolve at a synchronous speed, and assume the motor to be an ideal one. A motor constituted as shown in fig 7 is, I take it, a sufficiently close approximation to the shunt induction motor without a commutator—such, for instance, as the squirrel-cage motor. It is well known that such a motor will work as an ordinary shunt induction motor; it only remains for me to show that the theory I advanced with special reference to the motor shown in fig. 6 is also applicable to the form of that motor shown in fig. 7.

Consider the instant in which D coincides with the axis of the transformer field M, and C with that of the motor-field M_1. We know that M and M_1 are in quadrature, and if we assume a sinusoidal distribution of the fluxes, then fig. 8 will show us the values, directions and phase relation of

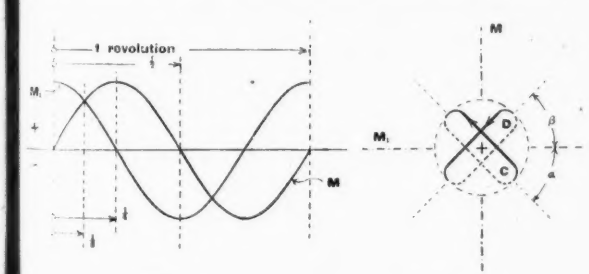


Fig. 8. Fig. 9.

M and M_1 at various stages of one revolution. Let the position of coils shown in fig. 7 correspond to the beginning of a revolution when M = 0, and M_1 = positive maximum.

M then produces E T in C by transformer action, when M = 0, then E T = negative maximum.

M_1 produces E B in C by rotation when M_1 = pos. max., then E B = pos. max., and is therefore opposed to E T, but we know that at synchronism $M_{max} = M_{1\,max}$, so that $E\,T_{max} = E\,B_{max}$, from which follows that the armature current in C must be *nil*.

M also produces E R in D by rotation when M = 0, then E R = 0, but i_2 lags 90° behind E R, and reaches a maximum for E R = 0. Because E R is opposite in phase to M, the maximum reached by i_2 will be positive, and M_1 = pos. max. At this instant $i_0 = 0$.

Now examine the conditions prevailing at the instant when coils C and D of fig. 7 have completed one-eighth of a revolution, and stand in the positions indicated in fig. 9. It is seen from fig. 8 that the instantaneous value of the two fluxes will at that moment be equal in magnitude and of the same sign, say, $M' = M_1'$. Designating by α and β the angles by which the coils C and D respectively are displaced from the normal to M, and omitting constants, we can write from figs. 8 and 9—

$$E\,T_c = -M' \cos \alpha, \quad E\,T_d = -M' \cos \beta.$$

Designating by α_1 and β_1 respectively, the angles of displacement of coils C and D from the normal to M_1, we can write from figs. 8 and 10, and by rotation in M_1—

$$E\,B_c = M_1' \sin \alpha_1 \qquad E\,B_d = M_1' \sin \beta_1,$$

but since $\alpha + \alpha_1 = \beta + \beta_1 = 90°$, it follows that $\cos \alpha = \sin \alpha_1$, and $\cos \beta = \sin \beta_1$, and because $M' = M_1'$ we have—

$$E\,B_c = M' \cos \alpha = -E\,T_c, \text{ and } E\,B_d = M' \cos \beta = -E\,T_d.$$

This is roughly indicated by arrows in figs. 9 and 10, and means that the armature current is nil, as before.

By rotation in M we have also, according to figs. 8 and 11—

$$E\,R_c = -M \sin \alpha \text{ and } E\,R_d = -M \sin \beta.$$

Each of these E.M.F.'s will produce a magnetising current in its respective coil. The instantaneous value of these currents i_{2c} and i_{2d} will be positive. But whatever the true direction of these currents, their relative directions in the two coils will be as indicated by the arrows in fig. 11, and it is very easy to see that the components of these

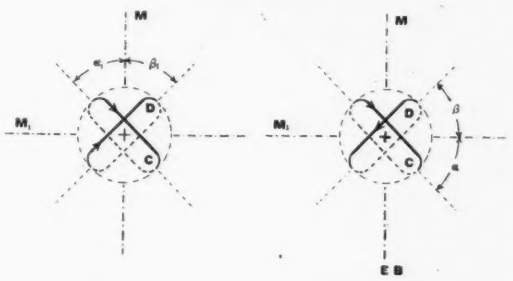


Fig. 10. Fig. 11.

currents in the direction M cancel out, whereas their components in the direction M_1 are fully effective. As before, it is the current i_2 due to E R which is responsible for the motor field M_1. At this instant $i_0 = i_2$ in magnitude.

After one-quarter of a revolution the coils occupy the positions shown in fig. 12, and it is seen that, as compared with fig. 7, the two coils have now exchanged their positions; M has now reached a positive maximum, whereas $M_1 = 0$. The conditions are now as follows:—

M produces E T in D by transformer action, when M = max., then E T = 0.

M_1 produces E B in D by rotation, when $M_1 = 0$, then E B = 0, there is no E.M.F. in coil D and no armature current. But M also produces E R in C by rotation, when M = pos. max., then E R = neg. max., but i_2 lags 90° behind E R, and when E R = maximum, then $i_2 = 0$, and there is no motor field, therefore $M_1 = 0$. At this instant i_0 = pos. max.

By this simple means it is easily seen that the theory I have put forward for the motor shown in fig. 6, also holds good for at least eight positions during one revolution of the motor without commutator, as shown in fig. 7. But if it holds good for eight positions, it will hold good for all or any, and the diagram fig. 13 will apply equally to both forms of the single-phase shunt induction motor.

I firmly believe that fig. 13 really represents the true conditions existing at no-load in a shunt induction motor

E

devoid of losses and leakages. I repeat that the E.M.F. (E_1) applied to the stator winding S (S is only shown in fig. 6, but is always coaxial with M) produces the stator magnetising current i_0 and the transformer field M lagging 90° behind E_1. In the armature axis we then have the working E.M.F. (E T) lagging 90° behind M, and the back E.M.F. (E B) due to rotation in M_1, and of same phase with it. In the field axis we have E R of opposite phase to M, and producing the magnetising current i_2 lagging 90° behind E R, and responsible for the motor-field M_1 which is in phase with i_2, and which leads M by 90°.

At synchronism : $E_1 = E T = E R = E B$, also $i_0 = i_2$ (in magnitude), therefore $M = M_1$. Because E T is equal and opposed to E B, there is no armature current in axis C C, of fig. 6, or in coil C, fig. 7. Along the field axis D D, fig. 6, or in coil D, fig. 7, we have a magnetising current, i_2. This current can have no inductive effect on the axis C C, fig. 6, or the axis of M, fig. 7 ; it is an entirely wattless current, and requires no energy for its production. Contrary to the generally accepted belief of the present day, the only current which S can carry at no load is the magnetising current i_0, responsible for the transformer field. This applies equally to the motor with and without a commutator.

It is quite true that two magnetising currents of equal magnitude are present in the single-phase shunt induction motor, and this fact, together with the rotary field theory, has, no doubt, led to the widely-spread idea that the no-load current of such a motor must be twice the magnetising

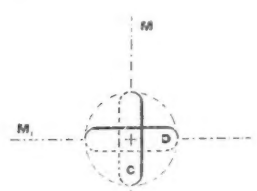


Fig. 12.

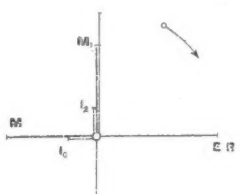


Fig. 13.

current. It must be borne in mind that one of these magnetising currents only is directly supplied from the mains ; the other, i_2 is derived from the motor itself, the latter acting as a generator. Since i_2 is purely wattless, and since the generator from which i_2 is derived is devoid of losses, no energy will be required to drive that generator or generate i_2. Comparisons are often instituted between single and two-phase shunt induction motors, and it is often said that they operate in the same manner : this is not so. The first is self-excited, the second is separately excited, and derives the magnetising current for both its fields directly from the mains.

I might add that what I have shown to be true of the two independently short-circuited coils of fig. 7 can be easily shown to be true of one such coil only when revolving synchronously. But if it be true of one and two coils, it will be true of any number of coils, consequently also of three coils, and will apply to a single-phase shunt induction motor, the rotor of which is, for instance, provided with a three-phase winding and connected to slip-rings in the usual way. It will also be true of any number of coils (n), and will therefore apply to a squirrel cage rotor.

Turning now to the other points raised by Mr. Pensabene-Perez, I am afraid I cannot agree with him when he says that the power factor of the motor in fig. 6 rises steadily until the machine comes to a standstill. I have tested many such motors, and have never found this to be the case, nor do I see any reason for it. It is true, however, that, for the same output, a squirrel-cage motor will, as a rule, have less resistance in the rotor, and when standing still its power factor will mostly be less, but I distinctly think that both motors must, when standing still, behave like short-circuited transformers with a good deal of leakage.

I should like to take this opportunity of saying that at the time I wrote the article which has given rise to this discussion, I was not aware that other investigators besides Mr. Atkinson had approached the subject in the manner suggested by him. I have since found that we are indebted to Potier, in France (1894), and Goerges, in Germany (1895), for highly interesting contributions dealing with the single-phase motor without the help of the rotory field theory.

Val A. Fynn.

London, S.E., *June 16th*, 1906.

Musical Jointers.

I regret to see that "Neither Mus. Bac. nor F.R.C.O." has taken exception to my letter in your issue of the 8th inst. respecting the above. I am sorry to see it had such an effect as is indicated by his letter, for I had not the slightest intention of probing his sensitiveness or hurting his tender feelings, and, of course, I was not to know that he was seeking amusement, which he states he failed to find in my commentary. At the same time, I trust he will forgive me if I plead guilty to such an offence as seeing humour when he is blind. I must say that, upon reading the advertisement, it struck me as being a very unnecessary requirement that a jointer should be a musician, for one could be pardoned for thinking that after doing a day's work at jointing, the man would be called upon to preside at the piano, or organ, or, perhaps, to render that tender little ballad, entitled, "Our Hands have met but not our Hearts" (the jointing in this instance being incomplete). Or, is a musical jointer chosen because of his vocal powers, and because he is able to while away the weary hours by singing whilst at work?—a beautiful sentiment, no doubt, but, on a large undertaking where many are employed, it would, I think, tend to make discord, especially if all were similarly inclined, and, perhaps, would distress even our sympathetic friend, "Neither Mus. Bac. nor F.R.C.O.," who, judging from his letter, leads me to believe he himself is, perhaps, a jointer with musical susceptibilities.

I thought my comment was explicit, but as your correspondent, who is not overburdened with any degree of imagination, fails to comprehend my meaning, I should like for his especial benefit, to explain that my reason for commenting upon the advertisement was, because I failed to see why a preference should be given to a musical man ; jointing being a purely mechanical graft, with no connection whatever with the musical art. Are we to understand your correspondent by his *nom-de-guerre* to be unacquainted with music? Surely not, (this is merely modesty on his part, and virtues such as this ought really to be appreciated) because he betrays himself in this, as also does he his ill-humour, and I might mention, indiscretion in quoting a phrase taken from a controversy which I have reason to believe was unpleasant to the parties concerned.

Your correspondent's expectations run somewhat high when he expects that the publishers will become inundated with applications for examination text-books from electrical engineers, for it does not follow that a purchaser merely of musical text-books will ever be in a safe position to boast of his musical knowledge ; this applies to men of all professions, even to jointers, as no doubt your correspondent is aware.

Witteystubb.

Inaccurate Electricity Meters.

I am of the opinion that it is permissible for the supply authority to estimate a consumer's account for any particular quarter, of course, basing its estimate on the number of units he consumed during similar quarters.

The meter, I take it, is only inserted for the convenience of the supply authority, and not as an infallible record as to whether the consumer has used the supply or not. Otherwise, if a meter fails to record the units consumed, has the supply authority to lose those units? I think not. If it prepares an estimate which the consumer pays without comment, then you may take it that the consumer has not lost.

Personally, I wish consumers would place a little more faith in the supply authority and its meters, and not think that the supply authority is the most selfish thing alive, and makes changes, &c., solely for its own benefit. The meter is also classed along with the supply authority, and many doubts are cast upon its accuracy.

I should like to state a case. One of our meter inspectors reported a certain meter as faulty. I went to inspect it, and found it was sticking, and required two 16-c.p. lamps to start it. The consumer, who had only been in the house three months, brought me his meter card with the monthly readings, which were 20, 10, 9 units respectively. He said his first month's reading was far too heavy, and would I get it altered. I kept my own counsel, but said I would look into the matter. On changing the meter, his next month's reading was 18 units. Obviously we had thus lost some 20 units.

Tester.

The practice of assessing electricity accounts where the working of the meter has been faulty is very general. It is not legal, but the County Court being a court of equity, it does not follow that the judge would not decree in favour of the supply authority.

"Meters" is under a misapprehension as to the testing of meters by the B. of T. being unusual. All meters in Dublin, Rathmines and Pembroke are tested by an electrical inspector, as not long ago a well-known man in the electrical world refused to pay on an uncertified meter. And any consumer would be within his rights in so refusing. It is time that inspectors were appointed for all parts, as electricity meters have got beyond the experimental stage.

Ubique.

With reference to your reply (Electrical Review, May 18th, 1906) to my question *re* certified meters, you must admit that in the case of small towns with large numbers of small consumers, a valid agreement with the local authority giving the undertakers the rights and privileges generally granted by provisional orders, is in practical working to be preferred. But such agreements, however carefully drafted, when tested in Court are found wanting. For small towns what really is required is a license granted by the Board of Trade, renewable for periods of, say, 20 years, provided the undertakers fulfil their duties in a fit and proper manner, the Board of Trade having power to grant and renew the same with the acquiescence of the local authority, independent of the House of Commons and the Board of Trade, reserving the rights of arbitrator in case of differences arising between the undertakers and local authority.

The experience of those who have worked without Parliamentary powers would be interesting. Usually they are sooner or later landed in some expensive law-suit. As a typical example of this, may be mentioned a town where the gas company and local authority do not agree very well, and with a view to forcing the hands of the former, they are fined every time they open a street.

K.

Street Lighting.

Your correspondent with the bad Latin, but otherwise appropriate pen-name, "Dulciter Dormans," mentions "certain simple little laws," one of which he goes on to propound, as follows :—The efficiency of a *white* reflector is nearly proportional to the cosine of the angle of reflection. (The said law possibly does not deal with reflectors of any other colour.)

From this he argues that sending rays of light back through the source from which they spring, and incidentally, through glassware in which about 10 per cent. of the light is absorbed for each thickness, is using a reflector at its maximum efficiency. But for scientific enunciation, the "simple little law" about the absorption of light knocks the last one into a cocked hat. It is "in proportion to the ratio of the superficial area and quantity of glass." Now this is absolute twaddle. The amount of light absorbed from any ray depends on the thickness, density and opacity of the glass through which it passes, and has been stated by authorities, for arc-lamp globes to be about 10 per cent. for clear glass, 15 to 40 per cent. for opal glass, 15 to 20 per cent. for holophane, and 42 per cent. for ground glass. The deduction to be drawn from "Dulciter Dormans's" laws is that the source of light should have as big a globe as possible ("larger globes absorb less light than the small ones,") and that the reflector should be part of a spherical area of which the source of light is the centre.

Now, if these be the quasi-scientific ideas that manufacturers have, we cannot wonder at the abortions they are pleased to offer us as street lanterns.

I agree with Mr. Turnbull that for small street lighting there is nothing of practical use available but the Nernst lamp, until we get a more adaptable high efficiency, simple filament lamp than we now have.

I notice "Dulciter Dormans" refers to dirt-proof lanterns, but can any *engineer* tell me where they are to be found?

Ubique.

As an interested follower of the recent discussion on the above subject which has appeared in your last two issues referring to the design of lanterns, pray allow me space for a modest comment.

Your correspondent, "Dulciter Dormans," has surely struck upon an unfortunate line of argument when he trots out his knowledge of the theory of reflection in support of his views as an "ordinary designer of reflectors." The "simple little law" quoted, however true it may be when taken in its right sense and put in its right place, is surely totally inapplicable to the present discussion.

Was it an unhappy inspiration of that "awful dream about the traditions of the electrical industry" which led "Dulciter Dormans," on awakening, to find that the quantity of glass required for the globes in question increased less rapidly than their superficial area?

The subscriber feels sure that if our friend had only paused a moment to rub his eyes before allowing that over-tender conscience to spur him on to the airing of "certain simple little laws," he would never have exposed those sleepy propensities which he has allowed to pervade his little article, and even to find a subtle witness in his pseudonym.

Question! Is it thus that the noble art of the "ordinary designer" is to prosper? No! Let him rather take the advice to heart—"Awaken!" "Listen to criticism," and "produce something more worthy of the traditions of the industry."

Rather than appear irrelevant of the real question at issue, and space permitting, I should like to venture a humble opinion on the method of producing "something more worthy, &c."

As a starting point, determine, from existing circumstances, the dimensions of the cone of light which is to be intercepted by the reflector. For street lighting, under general circumstances, it may be taken that no light should be projected by reflection or otherwise above the horizontal.

If O in the attached diagram be a source of light, and A and B points diametrically opposite on the outer circumference of a circular shade, this once and for all

determines the amount of light to be reflected, which is in no way affected by the cosine or any other function of the angle of reflection.

The next consideration would be, in what direction to reflect this intercepted light. As a standing rule—Avoid the source of light. That being decided upon, it is obvious that little or no light should be reflected into the inner circles of the area to be illuminated where the direct light is already disproportionately intense.

Use the reflected light, therefore, entirely for the outer circles of the area, and in such a manner as to keep the superficial illumination as nearly constant as possible throughout the required area. This can, undoubtedly, be done by employing a perfectly simple curve form for the section of the shade, as shown in the above diagram. However well these principles may be understood by "ordinary designers of reflectors," little or no attempt appears to have been made to put them into practice.

M. Tracey.

Electrolysis and Joint Boxes.

A perusal of the communicated article on the above subject in the ELECTRICAL REVIEW for June 8th shows conclusively that the author is entirely out of touch with the best practice. He says :—

Par. 1.—" . . . . We do not get much nearer immunity from joint-box troubles." This is contrary to facts! *Who are the we?*

Par. 3.—" Further, lead sleeve joints can only be properly used upon straight-through solid joints." The author's ignorance is unpardonable here, as lead tee joints, both on single and concentric cables, have been in general use on many large networks for over eight years!

Par. 4.—" At the beginning of recognised electrolytic troubles, about six years ago, &c." Electrolysis, so-called, was the cause of the abandonment of the underground laying of cable on its initial trial over 26 years ago, and for quite 15 years it has been quite a common term wherever lead-covered cables have been in use.

Par. 5.—The author's "chestnut" *re* the Manchester "smoke and shovel" method is really too ancient to call for comment here, other than to say that Manchester's huge network is in the hands of engineers well able to take care of it —and themselves, and then again, an advocate of glass boxes should not throw stones!

Par. 6.—The engineer who depends upon "proof tapes, &c.," to protect underground joints, deserves all he gets!

Par. 7.—To the present writer's certain knowledge, *there are systems* where the engineer can say—*and prove*—that his network is "perfectly and permanently bonded and earthed throughout; proof against electrolysis."

Par. 8.—Some proofs of the efficiency of the glass boxes would be welcome, also some comparative costs.

Par. 9.—When a plumber jointer is not reliable with the "Moleskin Wiper," the remedy must be obvious to all!

Par. 10.—*Re* "bushes at the glands for boring," these were condemned in Par. 4 because they "got damp, &c." Then we are naively informed that the surface of the box should be packed "to prevent a leakage of compound or oil." Wood bushes, packing of any description, and oil insulation were the three worst features in many of the obsolete type of joint boxes, and undoubtedly were, and are, where used, the cause of all electrolytic action.

Is not this bugbear of electrolysis more imaginary than real? More often than not the real cause is very near home, and it is often a rebound, like the echoes heard by the profane boy in the wood, or to vary an old proverb, electrolysis like chickens come home to "roost."

Sero sed Serio.

June 12th, 1906.

Your correspondent "Mains Engineer" has expressed a doubt as to the advisability of insulating lengths of L.C. cables from one another, and thinks that troubles may arise through such a system. May we, as owners of the patent rights for glass joint boxes, reply to his letter as briefly as possible?

Taking the example of the afflicted L.C., T.C. distributor whose punctured sheathing is so insulated by the soil it lies in as not to record an "earth" at the works; this sort of thing is in no way different from the conditions met with on most networks, especially those using other than lead-covered cables. In any case periodical testing, such as your correspondent rightly advocates, would cause such a fault to be observed and located before damage could be done. Single cables similarly.

We hardly care to discuss the leadless cables mentioned, beyond reminding your correspondent that they have been in use about 20 years, and that the type appears to be more used than ever, doubtless due to electrolytic troubles upon L.C. cables. Where L.C. cables are already in use, however, the question of bonding or insulating the lead should be carefully considered, with the understanding that an incompletely bonded system is the most dangerous. If this point is appreciated by those in charge of networks whose destinies have been presided over by mains engineers and jointers in relays, and whose joints are many and mainly forgotten, it will be found that there is a good case for thoroughly and frequently interrupting the lead circuit. In this way a path of maximum resistance is offered to the passage of vagrant currents, such resistance thus being spread all over the network and not located at one or two unbonded points. This fact has been recognised by some engineers, and endeavours have been made on certain networks to insulate at joint boxes by means of bushes, with the unfortunate results mentioned in your article.

We were interested to note that an American engineer, Mr. Wallace Clark, in a paper recently read before the Am.I.E.E. has come to similar conclusions. He says (in the April *Proceedings*) "If, therefore, we are compelled to use a lead sheath it should be interrupted by some form of insulating joint." Further, Mr. L. R. Lee's recent dictum, "Should we not see that the copper conductor is the only part of our cables that can carry current," is worthy of grave consideration as coming from an engineer in charge of about 1,000 miles of cables.

It seems clear that the only effectual insulating joint is one composed entirely of an insulating material, and glass has the following qualities which fit it for the purpose :— It is insulating, transparent, everlasting, cheap and strong.

Finally, we understand from the article on the above subject referred to by "Mains Engineer," that bonding is suitable where it is a complete and permanent system; but this state of affairs is so seldom attainable in practice that it is safer to go to the other extreme, on the Mohammedan principle that "Negative virtues are easiest to maintain."

pp. **Veritys, Ltd.,**
M. B. COTTERELL, *Director.*

Manchester, *June 19th*, 1906.

A Grievance.

I notice in this week's REVIEW a letter headed "A Grievance," and certainly, to my mind, "Rheostat" has a grievance, if his statements are correct. But, why on earth does he not mention the name of this particular firm who use such underhand methods of getting cheap labour?

What is the use of a public warning such as this, if his "fellow workman" does not know what firms to avoid?

R. N. Selby.

June 15th, 1906.

[There is nothing to prevent correspondents from communicating with "Rheostat," if they desire further information.—EDS.]

Flexible Wires.

Noticing the letter in this week's issue on flexible cords, and as no doubt "The Earlier Correspondent" in this letter refers to us, we should like to mention that we were not replying to a letter referring to the insulation of flexible cords but to the strength of the conductors.

We are quite in agreement with the remarks as to quality, &c., mentioned in this letter, and should like to mention that we are supplying a flexible cord made up of conductors of ample strength, insulated with pure rubber, and made as far as possible fireproof, finished either in silk, cotton, or workshop, which is extremely soft and flexible.

We also supply other different qualities of flexible, and find by using the best English rubber and compound, the flexible stands for almost any length of time without deteriorating.

Ward and Goldstone.

Manchester, *June 15th*, 1906.

I believe my letter to you of May 15th opened the above subject. I shall feel obliged if you will kindly add that I did not refer to cheap and badly-constructed flexibles, as appears to be assumed by the London Electric Wire Co.'s remarks in your issue of June 15th, but to high-class flexible of British manufacture, consisting of (35/40) copper wires lapped with cotton, two layers of very fine quality vulcanised rubber well vulcanised together, and braided with cotton. This was fired on more than one occasion by the strands on one of the conductors breaking at the lamp-holders due to constant angular bending.

I have since experimented with flexible wires insulated to the same specification as that mentioned by the London Electric Wire Co. which fired in a similar manner, so I can but repeat my former remark that this strongly points to the advisability of using fireproof flexibles, or of adopting some means of preventing sharp angular bending of the flexible at the terminal ends, to avoid the breaking of the strands at these points.

Charles J. Hall.

10, East Parade, Leeds.
June 18th, 1906.

Trolley Wire Maintenance.

As at the present time when the maintenance of trolley wire is more or less under discussion, the description of the system of anchoring the trolley wire which we have adopted very largely in Dublin may be of interest to some of your readers, as I am aware that the trouble due to trolley wires breaking and falling on the road is in some places very acute.

In over 99 per cent. of trolley wire breaks the fracture occurs close up to the point of suspension, due undoubtedly to crystalisation or brittleness developed at the place where the vibrations in each length of trolley wire are damped out.

The trolley wire is most likely to fracture first close up to the section insulators, as the wire is more rigidly held at this point than at frogs and crossings, and later on at the ordinary suspension ear.

Over eight years ago we anchored our wire at all section insulators, and about four years ago I had this method of anchoring extended to all frogs and crossings, as about 75 per cent. of the breakages were taking place close up to these fittings. Two years ago breakages began to be too frequent close up to the end of the ear, just within the ordinary line of the ear, and it became evident that a lot of the trolley wire would have to be renewed if the broken ends could not be kept off the road.

Anchoring at an ordinary suspension is not an easy matter, unless you go direct to the bracket arm or span wire, which means the expense of extra double insulation all through. We first tried to a limited extent replacing the old ears by longer ones to cover over the weak spot and get the point of flexure in a new place in the wire; but removing a well-soldered ear from a trolley wire is a slow job, and not a particularly good one for the wire where it is already weak. Finally, I decided on anchoring at every suspension of trolley wire that had been in service for two years. The system of anchoring we have adopted is one that has been designed and patented by my assistants, Messrs. Kirwan & Quaney. It is a very cheap and simple device for anchoring the trolley wires at the ordinary suspensions, either on span or bracket arm construction, without the employment of any extra insulation. The device as shown in the illustration consists of a galvanised steel plate with a centre hole of sufficient size to allow the threaded portion of the insulated bolt to pass through the plate, which is held firmly in position between the bottom of the insulated bolt and the ear. There is a hole and thimble at each end of the plate to which the wires from the half-anchor ears are secured. This forms a very neat construction, which costs in Dublin about £14 per mile of double track, to install on existing lines with suspensions 120 ft. apart.

When the trolley wire breaks it is held practically in position until the arrival of the emergency wagon, and the broken wire causes no trouble except that the trolleys may leave the wire until somebody is posted at the position to warn the conductors.

We have now about 38 miles of double track anchored in this way in Dublin, and since September last there have been 46 cases of broken trolley wire on the system, all of which have been kept from coming to the ground or blowing the station circuit-breaker, by these anchoring devices.

It is unnecessary to make any remarks as to the safety and advantages to be gained by making the fall of a trolley wire almost an impossibility, but with this system of anchoring it is possible, with safety, to get a much longer life out of your trolley wire; for the reason, that when anchored an occasional broken trolley wire loses its terror, and the wire can be kept in service in safety until too frequent breakage becomes a nuisance.

I may add that, by inspection of the trolley wire, practically nothing can be learnt of this incipient weakness due to crystallisation. I have seen many wires break where the section was full sized—for instance, ½ in. inside a splicing tube—and I may mention that I also take the precaution of having an anchoring device across every splicing tube on the system.

P. S. Sheardown, M.I.E.E.,
Electrical Engineer.

Dublin United Tramways Co.,
June 18th, 1906

The British Boiler Water Circulator.

Having had my attention called to an article on the above subject in your valuable paper of May 18th, I beg to take the liberty of saying that I consider some of your statements

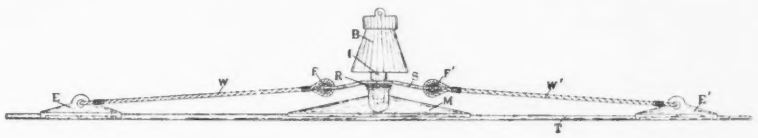


Fig. 1.—Elevation of Anchoring Device in Use at Dublin.

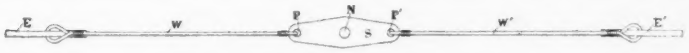


Fig. 2.—Plan of Anchoring Device.

very misleading; it may be, as you say, probably from lack of information. There is not the slightest resemblance between the British boiler circulator and the Hotchkiss boiler cleaner, and I fail to see how anyone could compare one with the other. The Hotchkiss boiler cleaner deals with the impurities in the water after precipitation has taken place in the boiler. The British boiler circulator is so constructed as to deal with the feed water before it enters the boiler proper. The apparatus is similar to an injector with an inner and outer cone: the feed water enters the centre cone, thereby inducing the water and steam from the surface through the outer cone to which the scummers are connected. The two currents from the Galloway tubes mix with the feed water just before entering the settling chamber, thereby bringing the feed water to a very high temperature, and causing the impurities in solution to precipitate and fall to the bottom of the chamber. The impurities are discharged through a pipe extending from the settling chamber to the boiler front, to which a high-pressure cock is fitted. The treated water passes out of the chamber at the other side through a pipe that extends to the bottom of the boiler, setting up a rapid circulation. With regard to your remarks comparing a Lancashire boiler to a water-tube boiler, I do not quite agree; I am of opinion there is no comparison. The water-tube boiler is acknowledged to be both a rapid steamer and a good circulator. The water in a Lancashire boiler, especially at the bottom, is very sluggish, and seriously impedes its steaming capacity causing unequal strains due to uneven temperatures, which does not exist in a water-tube boiler.

Thanking you for insertion in your next issue, which will be esteemed a favour.

The Patentee.

Boiler Efficiencies.

I am sorry that "Thermal Unit" finds anything I may say to be caustic. Far be it from me to make any caustic criticism, for my view of engineering matters is entirely an impersonal

one. I do, however, think that where efficiencies are taken in detail a spur will be given to efforts for improvement, since too frequently good results are apt to be credited to plant details which least deserve them. "Thermal Unit" asks what is to be done to determine steam wetness if there is no superheat and the calorimeter is useless. He may do one of two things. Either he may take the steam supply, so that he gathers no water with it; this is an excellent method for showing high boiler efficiency. Or he may superheat his steam even a few degrees only, and employ a thermometer to tell him the truth; this may not always be palatable at the moment, but it will at least save him from putting down results impossible of attainment. If "Thermal Unit" knows of a reliable method of finding the wetness of the steam in a pipe, and not that merely of a fortuitously extracted portion of that steam, he might do the engineering world a favour by disclosing such method.

W. H. Booth.

Coherers.

I wonder if any of your readers could explain the following action of the filings tube. The tube I have in my mind is the coherer, as used by the Marconi Co. The tube if left with terminals disconnected and insulated from each other is liable to be affected by an electric spark in such a way as to make the filings cohere. If, on the other hand, the terminals make contact with each other no cohesion takes place. I have never seen the reason of this explained in any text-book, and should like to have some theory on the subject.

C. A. Hill.

Brixton Hill.

Hard Retort Carbon Plates.

I shall feel greatly obliged to a reader who will give me information as to where I can obtain hard retort carbon plates suitable for the construction of adjustable resistances for lamp testing and meter calibrating; also particulars of the number and size of plates found most convenient for practical work. The resistance for lamp testing would be required to choke down from 0 to 10 volts according to the excess of the normal working pressure of 220 volts.

What advantages are claimed from the use of carbon resistances?

J. G. L. V.

London, *June 19th*, 1906.

Bad Business.—It is not for us to teach the electrical trade methods of commercial procedure, but we would say that the practice of addressing trade circulars to chief electrical engineers in envelopes marked "Personal" is as short-sighted and tactless as it is reprehensible. Vulgarly expressed, this sort of thing is calculated to get the recipient's "back up," rather than conducing to business. We have been asked to draw attention to the matter.—Eds. E.R.

Held Over.—We regret that, owing to the heavy pressure on our columns this week, and also to their late arrival, we are obliged to hold over a letter from Messrs. Johnson & Phillips, Ltd., on "Flame Lamps," and from Mr. C. V. Drysdale on "The Efficiencies of D.C. and A.C. Motors."—Eds. E.R.

Address Wanted.—A correspondent wants to know the address of the manufacturers or suppliers of Abbott's cleaning soap for brass-work, &c.

A Dublin Tramway Claim Settled.—At Dublin last week the case of the Pembroke District Council *v.* the Dublin United Tramways Co. was heard. Plaintiffs claimed £8,414 in respect of the widening and improvement of Ball's Bridge, on an alleged agreement by the defendants to repay the cost of the work. Defendants stated it was never contemplated to incur such a large expense, and offered £3,000 in discharge of their liability. After the case had been partly heard the parties came to a settlement, the company to pay £5,500 to plaintiffs.

BUSINESS NOTES.

Electric Power in Cotton Mills.—Messrs. Hodgson, Wright & Wood, of Century Works, Halifax, have just completed a cotton mill installation in the Yorkshire district. The plant consists of a 150-kw. 230-volt Willans-Dick, Kerr steam generator, which is fixed in the main engine room. The set is used both for power and lighting, and feeds on to a main switchboard provided with the necessary meters, circuit-breakers and switches. A new mill having been recently built it was decided to run by electric power. An 85-h.p. motor, of the four-pole open type, is installed for running two floors of the mill, and provision is made for fixing another of similar size. Each motor will have a separate motor house and drive through the wall by means of five cotton ropes on to the main line shaft. The motor is of the open type, which is allowable on account of the fireproof construction of the motor house. A liquid starter with slow motion gear is provided. A handy form of conveyor has been supplied and fixed by Messrs. Rawlinson's, Ltd., of Leeds. Power is supplied by a 3½-h.p. motor, manufactured by Messrs. Hodgson, Wright & Wood. The conveyor is provided with a steel runway, which projects from the mill door about 32 ft., and is used for lifting cotton bales directly out of the canal boats. One man can handle a bale of cotton weighing 6 to 8 cwt. quickly and with ease. The runway is supported by steel wire ropes, and has been tested to about 15 cwt. Power is also supplied from the steam set for driving the stokers and coal conveyors, for which a 10-h.p. semi-enclosed motor is provided. There is also a 2-h.p. motor for driving a slubbing frame by a chain drive and various fan motors. For pilot lighting after the large set has stopped, and for starting the stoker motor, a 10-kw. open type dynamo, made by the above-named firm, is installed, driven by a Robey single-crank engine.

The Venner Time Switch.—In our description of this switch which appeared in our last issue, we omitted to mention that it is supplied by Messrs. Venner & Co., of 6, Old Queen Street, Westminster, S.W.

Bankruptcy Proceedings.—Carl Hohmann.—An application was made on Thursday to Mr. Registrar Hope, at the London Bankruptcy Court, for an order of discharge on behalf of Carl Hohmann, Catherine Court, Seething Lane, E.C., and "Hawkhurst," St. Stephen's Gardens, East Twickenham. Mr. G. W. Chapman, Official Receiver, reported that the bankrupt in August, 1903, was trading at Catherine Court, E.C., and at Manchester, in partnership with others as a druggists' sundriesman. In that month he entered into a separate partnership for the purpose of conducting an electrical bath business at Victoria Park, Manchester, but the partnership was dissolved in February, 1904, and the bankrupt had since had to pay nearly £200 in respect of the liabilities, although they should have been paid by his partner. He attributed his failure to inability to recover his capital of £750, which he invested in the druggist sundriesman's business, and which was agreed on his retirement at the end of 1904 to be repaid to him by instalments; to the loss of the £200 which he paid in respect of the liabilities of the electrical business, and immediately to liability in respect of the druggist sundriesman's business, which his partner (also a bankrupt) ought to have paid. The failure took place last January; the liabilities amounted to £210, and the assets, which consisted entirely of the bankrupt's claims against his partners for £916 6s. 9d., had realised nothing. The only offence reported by the Official Receiver was that the assets were not sufficient to pay 10s. in the £ to the creditors. After hearing the bankrupt, who submitted that, in addition to the capital he put into the business, there was on his retirement sufficient assets therein to pay all the debts in full, his Honour held that the insufficiency of assets arose under circumstances for which the bankrupt could not justly be held responsible. He accordingly granted an immediate order of discharge.

T. C. Hodgkinson.—At the same sitting the public examination was held of Thos. Clement Hodgkinson, dealer in electro-medical apparatus, trading as "The Electro-Neurotone," at 186, Goldhawk Road, Shepherd's Bush. The accounts showed total liabilities £2,060 1s. 5d. (unsecured, £541 6s. 5d.), and assets £275 4s. 6d. Replying to Mr. G. W. Chapman, Official Receiver, the debtor stated that in 1888 he commenced business with about £400 capital as an electrical engineer and instrument maker at Melbourne. In 1892 he returned to England for the purpose of exploiting a patent electro-medical apparatus which, in 1897, was taken over by the Electro-Neurotone Co., Ltd., a company formed by witness and others with a share capital of £5,000. He received £1,500 in shares, and was appointed managing director of the company at a salary of £150 a year. In 1903 the company went into voluntary liquidation, with a view to forming a larger company, but the negotiations fell through, the business having been carried on at a loss. Witness subsequently took over the invention and the business from the liquidator for £1,500 and 5 per cent. interest. He paid one instalment and had since carried on the business alone, but was unable to make it pay. The failure was due to want of capital, to his having agreed to pay too high a price for the business, and immediately to pressure by a creditor. The examination was concluded.

S. R. and B. R. Cohen.—Under a receiving order made on May 28th against Samuel Raphael Cohen and Barnett Raphael Cohen, lately trading at 6, Bank Parade, West Kensington, as Cohen Bros., the first meeting of creditors was held on Wednesday at the London Bankruptcy Court before Mr. W. P. Bowyer, Assistant

Official Receiver. The debtors were, until March 15th, 1905, in partnership with Mr. L. C. Ingram (petitioning creditor) as electrical engineers. There are no outstanding debts of the partnership, and the only liabilities are a sum of £60 6s. 9d. due to Mr. Ingram under the terms of the dissolution and the amount of the solicitor's costs for which no account has yet been rendered. The debtors stated that they started the business in December, 1902, with a joint capital of £150. In October, 1904, they were joined by Mr. Ingram, who provided £150, and later £75, in return for a share of the business, and remained a partner until the dissolution in March, 1905. They ascribe their failure to loss on the partnership trading. In the absence of assets or a proposal, the case was left in the hands of the Official Receiver to be wound up in bankruptcy, the debtor's public examination being fixed for July 11th.

Argentina.—The Compania Industrial de Electricidad del Rio de la Plata has recently been formed with a capital of $2,000,000. It has been established to acquire the following businesses: Juan Carosio & Co., importers and electrical contractors and agents for the Allgemeine Elektricitäts Gesellschaft, of Berlin, and Franco Tosi, of Legnano, Italy; the Carbon Factory of La Tentonia Co.; the Mechanical Workshops of Negroni, Hermanos and Co. The vendors receive $325,000 in shares, and $145,000 in cash.

Underfeed Stokers.—The UNDERFEED STOKER CO. have received the following orders for the equipment of water-tube boilers, with their stokers:—

Charing Cross, West End and City Electric Supply Co., Ltd.—Two Nesdrum boilers.
Poplar Electricity Works.—One Stirling boiler.
Stepney Electricity Works.—One Babcock boiler.
Spiers & Pond's Electric Generating Station.—Three Babcock boilers.

For the equipment of internally-fired boilers:—

South Wales Electrical Power Distribution Co., Ltd.—Nine Lancashire boilers.
Hull Corporation Electric Lighting Works.—Eight Lancashire boilers.
Falkirk Electricity Works.—One Lancashire boiler.

Fined.—An Eastbourne tradesman named Weller has been fined £2 and 6s. costs, for unlawfully laying an electric line to communicate with the Corporation wires. He was supplied with electricity for a motor, but with the aid of bell wire he used the current for lighting purposes. He had been previously warned.

South Wales Power Co.—While waiting for its Bill authorising the issue of further capital to pass through Parliament, the South Wales Electrical Power Distribution Co. is suspending its development work, and about six engineers connected therewith are affected. The company's various power stations are, of course, going as usual.

Receiver Appointed.—BURNAND TRANSFORMER CO.—At the Lancashire Chancery Court last week, Mr. Grant applied, on behalf of the plaintiff in the case of Hutton *v.* the Burnand Transformer Co., Ltd., and Hanchett, for the appointment of a receiver and manager of the company's assets and business. Counsel said the plaintiff was the holder of the whole of the first debentures issued. The company, which was incorporated in March, 1902, and carried on the business of electrical and mechanical engineers in Salford, had an execution issued against it for £29, which it could not pay, and that and interest being in arrear, had made the debentures immediately payable. His Honour directed a reference to the Registrar to appoint a receiver and manager, who was not to act for more than three months without a further application to the Court.—*Manchester Daily Guardian.*

Trade Announcements.—As mentioned in our "Personal Notes" to-day, Mr. A. C. EBORALL is, during the course of the present month, resigning his seat on the board of Messrs. Witting, Eborall & Co., Ltd., for the purpose of becoming managing director of Messrs. Brown, Boveri & Co., Ltd. This latter company is now in course of formation by the well-known Swiss company of the same name, its main objects being to take charge of the interests of the Swiss company in Great Britain, the Colonies, and various other countries. The other directors of the English company will be Messrs. Charles Brown, W. Boveri and C. Baumann, who are also directors of the parent company in Baden. The English Brown, Boveri Co. has further arranged to purchase the well-known contracting business of Witting, Eborall and Co., Ltd., and to carry it on and further develop it as a part of the business of Brown, Boveri & Co., Ltd. As a result of this, Messrs. Witting, Eborall & Co., Ltd., have ceased trading, as far as new work is concerned, while their work and contracts in hand, and their various British and Colonial branch offices and agencies, are being taken over, as far as is practicable, by the new company. The offices of Messrs. Brown, Boveri & Co., Ltd., will be situated (after the 23rd inst.) at Caxton House, Westminster, and on that date Messrs. Witting, Eborall & Co., Ltd., are also removing their offices from Temple Bar House to that building, where they will remain until such time as various outstanding matters connected with the settling up of their business affairs have been arranged. The English Brown, Boveri Co. will have the whole of the resources and experience of the Swiss company behind it, which is now a concern with a capital of £640,000, having works in Baden (Switzerland), Mannheim, Paris, Christiania and Milan in which altogether over 5,000 men, and about 500 engineers and officials are employed.

MESSRS. WITTING, EBORALL & CO., LTD., have asked us to state that, as a consequence of the above-mentioned purchase of their business, all future inquiries or correspondence in respect to new work, or work in hand, should be addresed to Brown, Boveri and Co., Ltd., at Caxton House, as above, and all correspondence for them should also be sent to the same address; also, that the working arrangement which has existed between them and Messrs. Ferranti, Ltd., for some time, in respect to switchgear and other manufactures of that firm, has come to an end as a result of the new arrangements, and in consequence, all inquiries for Ferranti material should in future be addressed directly to Hollinwood.

MESSRS. CUTTING BROS., LTD., have opened a show-room at Park Works, Stamford, where a stock of electric motors is held. The firm has issued a card giving net wholesale prices and specification of these motors.

MESSRS. GENERATORS, LTD., have removed from Trevelyan Buildings to 79, Corporation Street, Manchester, where they have large and well-lighted show rooms, and are holding a stock of starting switches, traction material, Reason arc lamps and Vitæ carbon brushes.

Mr. J. E. LAWLER, of 39, Lime Street, E.C., notifies that in future his business will be carried on under the title of J. E. Lawler & Muirhead, Mr. J. A. Muirhead, civil and mechanical engineer, having entered into partnership with him. Mr Muirhead takes to the new firm the representation of Messrs. Edwin Danks & Co. (Oldbury), Ltd. Mr. Lawler was already agent for Messrs. Fleming, Birkby & Goodall, Ltd., and other companies.

MESSRS. MOORES, FARRELL & CO. have changed their name to J. Moores & Co., and their offices are from June 1st at 37, Blackfriars Street, Manchester.

The Brown-Boveri Italian Tecnomasio.—The general meeting of this company was held on May 27th under the presidency of the Marquis Visconti. The 1905 balance-sheet showed a net profit of £2,340, including the amount brought forward from the previous year. A dividend of 5 per cent. was declared on preference shares, and 2½ per cent. on the ordinary shares.

Italy.—The Bergamo Co. for Distribution of Electrical Energy recently held their general meeting to consider the balance-sheet for 1905. The report shows that the maximum output amounted to 4,038 KW., distributed to 1,602 consumers, employing 21,921 incandescent lamps, 255 arc lamps, 382 motors, and 49 sundry apparatus. The profit balance for the year amounted to nearly £7,000, on which it was decided to pay a 4½ per cent. dividend on the ordinary shares.

Importation of Coal into Italy.—During the first three months of this year there has been a considerable increase in the quantity of coal imported into Italy. The total amounted to 1,994,492 tons, exceeding by 654,000 tons the quantity imported during the similar period for 1905, proving the rapid growth of the industrial undertakings in Italy.

For Sale.—The engineering business of the GOODFELLOW ENGINEERING CO., LTD. (in liquidation), is offered for sale as a going concern. Some particulars appear in our advertisement pages to-day.

Book Notices.—"Das Spektrum des von den Strahlen des Radiotellurs erzeugten Stickstoff-lichtes." By B. Walter. Excerpt from *Annalen der Physik.* Leipzig: J. A. Barth.

"Repetitorien der Elektrotechnik." Edited by A. Konigswerther. No. IX, "Stromverteilungssysteme und Berechnung Elektrischer Leitungen," by P. Häfner. Hanover: Dr. Max. Jänecke. M. 8.

"Wissenswertes aus dem Dynamobau fur Installateure." By E. Schulz. Hanover: Dr. Max. Jänecke. M. 2.20.

"Electric Wiring." By W. C. Clinton. London: John Murray. 2s.

"Electricity in Homes and Workshops." By S. F. Walker. Fourth edition. London: Whittaker & Co. 5s. net.

"Transactions of the Junior Institution of Engineers." Vol. XV, Session 1904-5. London: Percival Marshall & Co. 10s. 6d.

"Electric Power Transmission." By Louis Bell. Fourth edition. London: Archd. Constable & Co., Ltd. 16s. net.

"Directory of the Engineers' Club of Philadelphia." List of officers, members, &c., corrected to April 7th, 1906.

Catalogues and Lists.—MESSRS. MATHER & PLATT, LTD., Salford Iron Works, Manchester.—12-pp. catalogue (third edition) giving illustrated description of their polyphase induction motors with tabulated particulars of speeds, number of poles, code words, dimensions and weights; starting switches for "squirrel-cage" motors are also included.

THE NEW BRITISH ELECTRIC SUPPLY CO., LTD., 43, Stoke Newington Road, N.—Various illustrated sheets giving information concerning their manufactures, including "Arcazon" long burning arc lamps, enclosed, twin carbon, photo-printing, and midget arc lamps, ventilating fans of different types, small power motors, motor lathes, motor starters, rheostats, resistances, choking coils, &c. A sheet of code words for different types of arc lamps is issued.

MESSRS. DRYSDALE & CO., Bon-Accord Engine Works, Glasgow.—Revised catalogue (No. 14) of centrifugal pumping machinery. Some 73-pp. are occupied with a great deal of general information, partly of a descriptive kind and partly in tabulated form, concerning their "Bon-Accord" pumping engines of many different types, including electrically driven. A large number of excellent half-tone blocks are used in the illustration of the publication. Several

pages at the end are devoted to useful information concerning friction in pipes and other matters of interest in connection with the class of engineering work with which the catalogue is concerned.

THE A.B.P. ACCUMULATOR CO., LTD., 47, Victoria Street, S.W.—This company has issued a "Battery Record" book, the pages of which are forms in which attendants may keep a record of the performances of batteries. The first few pages are devoted to working instructions and explanations compiled to enable attendants to appreciate the necessity for careful use of batteries.

The GENERAL ELECTRIC CO., LTD., London, E.C.—The June "Progress" sheet issued by this company contains illustrations and prices of their "Security" lamp guards, fuseboards, automatic circuit-breakers, P.O. telephone wall sets and a notice of reductions in prices of iron mining and outdoor bells and cut-out boards.

The EAST ANGLIAN ENGINEERING CO., LTD., Stowmarket.—Illustrated price list of continuous-current "Bull" motors, with dimensional drawings.

MESSRS. HODGSON, WRIGHT & WOOD, Halifax.—Price list of semi-enclosed motors, ¼ to 32 B.H.P.

MESSRS. MARPLES, LEACH & CO., London, E.C.—Price list No. 102A, giving particulars, dimensions, prices, &c., of their single-phase alternating-current motors, which are claimed to be self-starting against full load.

MESSRS. CROMPTON & CO., LTD., Salisbury House, London Wall, E.C.—Two new publications of their standard size relating to arc lamps. No. P27 gives very fully detailed particulars of their open-type lamps, single and double carbons, also of the inverted type, special fittings, resistances and accessories; P25 deals in a similar manner with the enclosed lamps (A.C. and D.C.), various patterns being shown. Both pamphlets are well arranged, finely illustrated and contain particulars of prices.

MESSRS. LUNDBERG, Liverpool Road, N.—A small postal card (measuring 10 in. × 12 in.) giving illustrations and prices of a number of their "Lektrik" specialities such as ceiling roses, see-saw switches, tumbler, pivot combination, and various other switches.

Dissolutions and Liquidations. — WALLACE LAMP SYNDICATE, LTD., Newington Butts, S.E.—This company has gone into voluntary liquidation with a view to reconstruction. Mr. F. Wiedmann has been appointed receiver on behalf of the debenture shareholders.

INTERNATIONAL ELECTRIC TRACTION AND POWER SYNDICATE, LTD.—This company has resolved to wind up voluntary, with Mr. J. Morris, 33, Brazennose Street, Manchester, as liquidator.

AUTOMATIC LIGHT CONTROLLING CO., LTD.—This company is winding up voluntarily, with Mr. J. Gunning, 100, Holdenhurst Road, Bournemouth, as liquidator.

SOL MANUFACTURING CO.—This company is winding up voluntarily, with Mr. Edward Hobbs, 27 and 28, Old Jewry, E.C., as liquidator.

BRITISH PRISM GLOBE ELECTRICAL CO., LTD.—A meeting is to be held at 35, Brown Street, Manchester, to hear an account of the winding up.

HELICOID LOCKNUT PATENTS (PARENT) CO., LTD.—A meeting is to be held at 26, Victoria Street, S.W., on July 19th, to hear an account of the winding up from Mr. Alfred Lenton, the liquidator.

WRIGHT'S TAPER ROLLER BEARINGS, LTD.—A meeting is to be held on July 18th at 57, Moorgate Street, E.C., to hear an account of the winding up from the liquidator (Mr. E. C. Price).

LIGHTING and POWER NOTES.

Australia.—SYDNEY.—Mr. Rooke, the city electrical engineer, has recommended the Council to reduce the price of energy for power and heating from 2d. to 1½d. per unit.

On the suggestion of the engineer, the Committee has decided to recommend the C.C. to invite tenders immediately for a further stock of distributing cables, at an estimated cost of £10,000.

Bulawayo.—At the annual meeting of the Bulawayo Waterworks Co., held in London last week, it was stated that the sale of electrical energy fell off during 1905, the number of units sold being 164,987, compared with 185,348 in 1904; the profit was £4,553, compared with £5,669. Considerable economies in working were effected, amounting to over £800. In regard to the action brought by the company against the Bulawayo Municipal Council to determine the price at which energy was to be supplied, it was not at present possible to state how the action would affect the accounts, but it was hoped that as the improvement in business generally continued throughout Rhodesia, the demand for electric light in the town would also increase.

Burnham (Somerset).—A private company has asked the U.D.C. if it will approve of an E.L. scheme for the district. Notice of a motion has been given that the company be supported by the Council.

Canada.—Our Dominion correspondent writes:—The Hydro-Electric Power Commission of Ontario, legislated for under the Act passed at the recent session of the Legislature "to provide for the transmission of electrical power to municipalities," has been appointed as follows:—Hon. Adam Beck, M.P., chairman; Hon. J. S. Hendrie, M.P.; and Mr. Cecil B. Smith, consulting engineer. This new Commission is empowered to carry out the Government's policy of supplying municipalities with cheap electrical power. The primary principle of the Power Bill is the fixing of rates by the Commission. This applies to existing or projected companies or undertakings for the supply of power which the Government (through the Commission) and the municipalities may enter into. The Commission has also the right to expropriate existing plants, and to arbitrate on all complaints as to rates, &c. In view of the many splendid water powers to be developed in the Province of Ontario, it is thought that the Provincial Government Cabinet will be increased in the not distant future by the addition of a "Minister of Power."

Cardiff.—The assessment on the Corporation electricity undertaking has been reduced on appeal from £6,500 to £4,500. The previous figure was £1,810. The assessment on the tramways had been previously reduced from £20,000 to £15,000.

Chichester.—At the meeting of the T.C. on June 15th it was announced that nominally the B. of T. had given consent to the transfer of the E.L. order to the local E.L. and Power Co., and that energy would be supplied by December.

Clacton-on-Sea.—A L.G.B. inquiry was held on June 11th into the application of the U.D.C. for a loan of £1,000 for the purchase of the private E.L. installation of Mr. Ainslie, from which 32 properties are supplied. It was stated that by this means opposition to the Council's new electricity undertaking would be avoided. There was no opposition, the only point raised being as to the Council's power to purchase the goodwill of a business.

The U.D.C. electric light installation was inaugurated a week or so ago, when energy was supplied to the Palace Theatre and grounds. The three-wire direct current system of supply has been adopted, the total estimated expenditure being £13,000. The plant consists of two Davey-Paxman gas engines of 180 B.H.P., using town gas, coupled to 110-KW. generators giving 220 amperes at 500 volts. Energy is to be supplied to consumers at 5d. per unit for lighting, and 3d. per unit for power purposes. The Council does not propose to use the electric light in the streets at present.

Continental Notes.—ITALY.—The Prefect of Cuneo has conceded to Signor Luigi della Beffa a derivation of the Varalla Stream of sufficient quantity to generate 7,781 H.P. By the construction of a canal of nearly 4½ km. in length, it will be possible to utilise a fall of 73 metres, returning the water direct to the same stream from which it was taken. The gradient given to the canal forming the headrace will be 1·3 per thousand. The downtake tubes are to be built of steel, 1½ metres in diameter, and six turbines will be installed to utilise the fall. The energy generated is to be used for public and private lighting, tramway working and electro-chemical processes. The total estimate for work is 1,708,000 liras, say, £68,500.

The Common Council of Brescia has put forward a request to the Prefect for the concession of a waterfall containing about 7,000 H.P. in the Valley Dezzo, the power to be used for electrical distribution for the city and neighbourhood, for public lighting and industrial purposes.

The authorities of the province of Massa have granted a concession for a hydro-electric plant at Fivizzano on the River Rosaro.

RUSSIA.—It is reported that the works of the Compagnie Centrale d'Electricité de Moscou, of Moscow, have been taken over by the Westinghouse Electric Co.

GERMANY.—The electric lighting station in the town of Lubeck is to be extended at an estimated cost of £25,000.

HOLLAND.—Contracts have just been let by the municipal authorities of Leyden for the construction of a central electric lighting station in the town.

SPAIN.—There seems to be no cessation in the desire to adopt electric lighting in the small provincial towns of Spain. Among the municipal authorities that have just invited tenders for the concession for the public and private lighting are those of Pozo-hondo (Albacete), Trigueroo (Huelva), and Ayna (Albacete). In the first case the concession is for a period of 10 years; in the second, 15; and in the third, 20 years.

Coventry.—The chairman and manager of the E.L. undertaking having inspected switchboards made by various firms submitting tenders for the same, and recommended that the tender of the British Westinghouse Co., amounting to £1,452, be accepted, subject to a proper contract and to the sanction of the L.G.B. being obtained to the necessary loan, which the E.L. Committee agreed to. The Committee also considered the tenders received for the supply of two new boilers, and it was resolved that the tender of Messrs. E. Danks & Co., of Oldbury, amounting to £1,282, be accepted. The question of obtaining a third new boiler was referred to a sub-committee.

Cuckfield.—The R.D.C. has received from the Hayward's Heath Electric Supply Co. an intimation that the company intends to apply for a prov. order for E.L. within the districts of the R.D.C. and the Hayward's Heath and Cuckfield U.D.Cs.

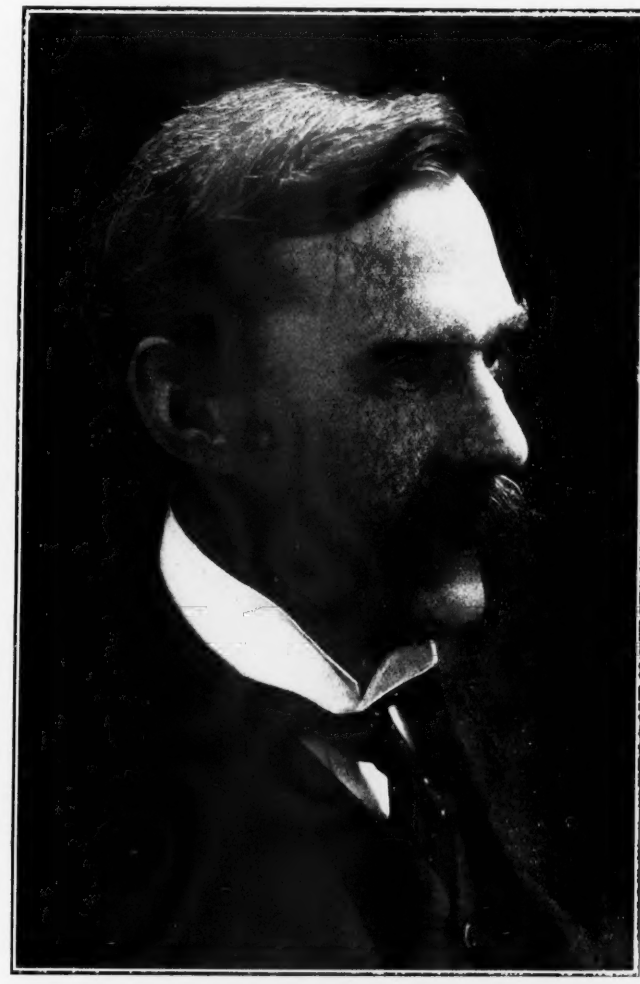
Dublin.—A sub-station building is to be erected at Clontarf, at a cost of about £360.

Edinburgh.—The T.C. has, against the advice of its experts, decided by 20 to 14 not to fulfil at once its statutory obligations in regard to the E.L. reserve, and not to provide a depreciation or suspense fund to the extent of 5 per cent., as recommended by Sir Alexander Kennedy and the committee.

(Continued on page 1007.)

Dr. R. T. GLAZEBROOK, President-Elect I.E.E.

Dr. Richard Tetley Glazebrook, Director of the National Physical Laboratory, and President-Elect of the Institution of Electrical Engineers, was born at Liverpool, Sept. 18th, 1854, his father being the late Nicholas Smith Glazebrook, M.D., of West Derby. He was educated at Liverpool College and Trinity College, Cambridge. He graduated B.A. in 1876, being fifth Wrangler, and the following year was made a Fellow of his college. He commenced the study of physics under Clerk Maxwell at the Cavendish Laboratory, and after the death of Maxwell was appointed by his successor, Lord Rayleigh, as demonstrator in 1880. He was made a lecturer and assistant tutor of his college, and afterwards Senior Bursar. At the same time he was assistant director of the Cavendish Laboratory under Prof. J. J. Thomson, and held this position till 1898, when he was appointed Principal of University College, Liverpool. During his career in Cambridge, Dr. Glazebrook exercised a considerable influence on the teaching of natural science, and wrote numerous text-books on elementary physics for the Cambridge series, one of these being the "Practical Physics" written in conjunction with Mr. Shaw, which has in its various editions been the first guide to physical laboratory work to large numbers of students. While at Cambridge he was for some time secretary, and afterwards treasurer, of the Cambridge Philosophical Society, and was also a member of the University General Board of Studies. His most prominent contribution to science has been his work as secretary of the Electrical Standards Committee of the British Association, an office which he has held since 1883. This Committee has always led the way in systematising our knowledge, and settling the definitions of the various standards of electrical measurement. During the Edinburgh meeting in 1892 a specially important electrical conference was held, at which Prof. Helmholtz and other eminent foreign physicists attended, and at this meeting the present universally accepted international standards of the ohm, ampere and volt were defined.



Richard Tetley Glazebrook, M.A., D.Sc., F.R.S.

Dr. Glazebrook was a member of the Board of Trade Electrical Standards Committee, and determined the value of the original standards of the Board of Trade by comparisons with the B.A. units in his charge at Cambridge. After a brief period at Liverpool Dr. Glazebrook was appointed Director of the National Physical Laboratory, taking up his duties from January 1st, 1900. For a post of this kind many qualifications are desirable, hardly to be found combined in one individual. The members of the staff engaged in the most diverse tests and researches should have in the director a man with whom they can discuss their difficulties, and to whom they can go for inspiration and advice. He should represent the institution on official occasions, and during its early career should be able to make known at suitable opportunities its aims and the work it seeks to do. Finally, the director must be able to get through a voluminous correspondence, and manage the business side of a large institution, where finances have to be most carefully considered. In our opinion, it is in these latter directions that Dr. Glazebrook's ability has shown itself most conspicuously. The rapid growth of the laboratory during its short existence, as evidenced in succeeding pages to-day, testifies to the work it is doing and the many-sided character of its usefulness.

Dr. Glazebrook married Frances Gertrude, daughter of the late J. W. Atkinson, of Leeds, and has one son and three daughters. He is an M.A. of Cambridge and Hon. D.Sc. of Victoria Universities, and has been a Fellow of the Royal Society since 1882, was President of the Physical Society in 1904, and is President-Elect of the Institution of Electrical Engineers. He is a cyclist, enjoys a game of golf, is an enthusiastic mountain climber, a member of the Alpine Club, and of the Athenæum. He is the author of a number of papers in the *Proceedings of the British Association*, the *Philosophical Transactions*, *Proceedings of the Royal Society*, and the *Philosophical Magazine*, among which may be mentioned :—

"On the value of the British Association Unit of Resistance in Absolute Measure," "On the Specific Resistance of Mercury," and "On the Clark Cell as a standard of Electromotive Force," published in the *Philosophical Transactions*, and the numerous reports of the Electrical Standards Committee, many of which are occupied with the work on the resistance standards of the British Association, which have been under Dr. Glazebrook's care for so long a period. Our portrait is from a photo by Miss Edis, The Studio, Sheringham, Norfolk.

THE NATIONAL PHYSICAL LABORATORY, BUSHEY HOUSE.

On Monday next the new electro-technical building of the National Physical Laboratory is to be opened by the Right Hon. R. B. Haldane, Secretary of State for War. We, therefore, propose to lay before our readers some account of the newer work of the laboratory and its recent developments, particularly in electrical matters. By the courtesy of the laboratory authorities we are able to append illustrations of many of the departments, including views of the new buildings.

BUSHEY HOUSE FROM THE SOUTH.

From the report for the year 1905 we gather that the scientific staff at Bushey House now numbers 20 persons, and that about 30 others are also employed in different capacities. The electrical work is split up into a number of sub-divisions, and of the 12 assistants in the physics department six are occupied partly or wholly with matters electrical. The first subdivision, that of fundamental units, is a continuation of the work, which before the establishment of the laboratory, was

THE THERMOMETRIC LABORATORY: FURNACE ROOM, SHOWING MOISSAN ARC FURNACE AND BATHS FOR THERMOMETER TESTING.

carried on at Cambridge by Dr. Glazebrook, as secretary of the Electrical Standards Committee of the British Association. The most interesting novelty in this department is undoubtedly the new ampere balance, an account of which is to be given at the forthcoming meeting of the British Association. It was designed by Prof. Ayrton and Mr. Mather, and made partly by Mr. Oertling, and partly at the laboratory, from drawings by Mr. Gregory. Some initial difficulties were found, but these were overcome by the perseverance and ingenuity of Mr. Smith, who has charge of the instrument, and it is now possible to make a complete determination of current in half-an-hour, the differences between the observations of different days being only of the order of 0·001 per cent. Calculations of the force between the fixed and moving coils, when carrying a current of one ampere were made at the laboratory, and by Mr. Mather independently, and agree to 0·0001 per cent. A determination of the electro-chemical equivalent of silver is now in progress, various modifications of the silver voltameter, including some new and improved forms, being tried in this connection. Though no definite figures as to the results of the researches made with the ampere balance may be published, we understand that according to the experiments already made, the statement that "the E.M.F. of the Clark cell at 15° C. represents 1·434 volts to an accuracy of one part in a thousand" is not likely to need serious modification.

Exterior of the New Electrical Buildings.

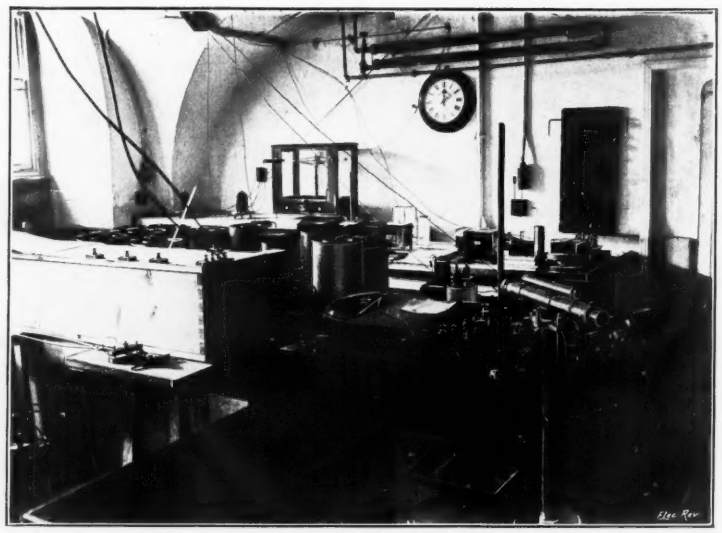
General Electro-technical Department.

The New "Resistance" Room.

The New Photometric Standards Room.

In the department investigations on standard cells and resistance standards are also in progress. We mention the latter at the present time with some trepidation, lest, out of the new ampere and the new volt, someone should dare to evolve *another new ohm* to render the confusion at present reigning between the various ohms even worse confounded. We notice that lately, in order to avoid complications between "international ohms," which are *not* international, Board of Trade ohms, and the seven other kinds, the laboratory authorities wisely state the value of a standard coil in "ohms" only, leaving it to the initiative of the bold to make further inquiry.

In the department for general electrical measurements Mr. Campbell has carried on a number of interesting researches. In the metallurgy department a number of steels were being made of widely varying electrical properties. In order to successfully study the permeability of these on the well-known Ewing bridge, Mr. Campbell found that it was un-

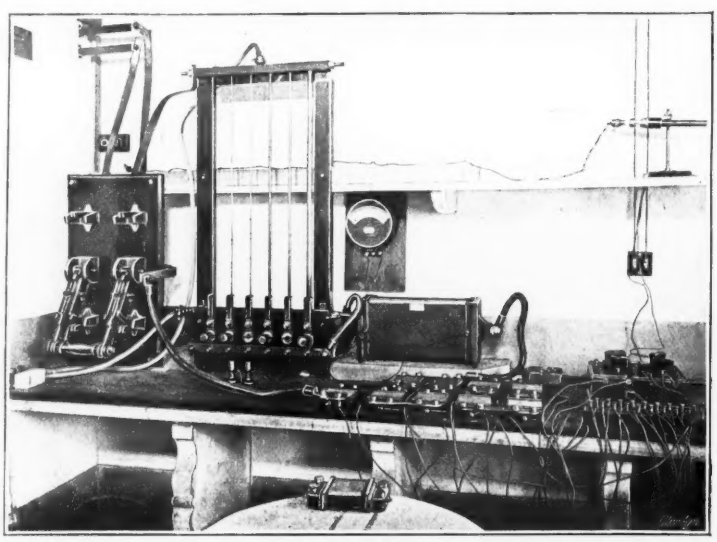


The Electrical Standards Room in the Old Building. Showing the arrangement for testing standard resistances.

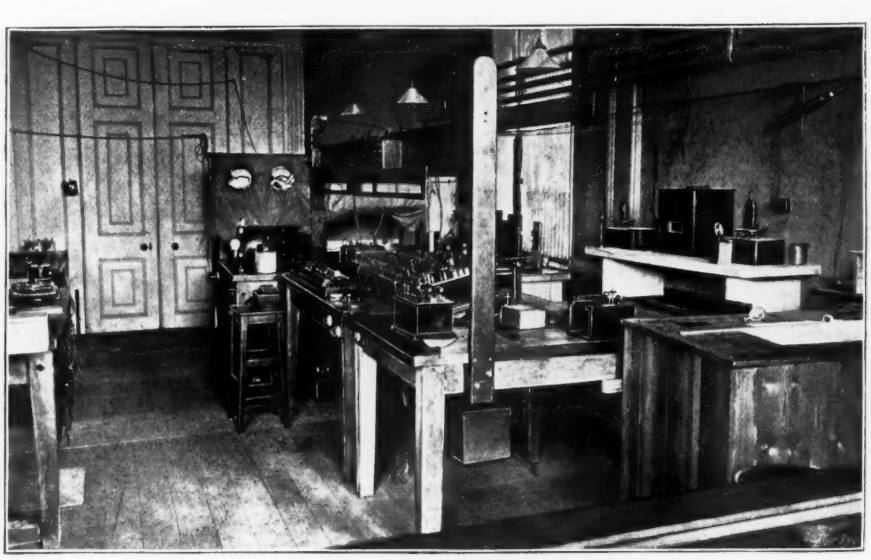
desirable in all cases to use as standards the very soft and highly permeable rods usually supplied, but to select in each case from a range of standards, one whose "apparent permeability" approximated to that of the sample to be tested. Another research of interest dealt with the specific inductive capacity of the various kinds of paper used in telephone cables. For this research Mr. Campbell designed the high frequency "buzzer," now also used by the Post Office in their work, to obtain conveniently the necessary quick periodic charge and discharge of the small condenser, the dielectric of which was formed by the sample of paper under investigation.

In the department for continuous current tests the work has greatly increased during the past year. The testing of ammeter shunts with currents up to their maximum rated capacity has necessitated the construction of special apparatus. The maximum available energy for the purpose in the old building is derived by paralleling one of the batteries, which yields currents up to about 1,500 amperes at 10 volts. In the new buildings it is contemplated to have at once, cells suitable for giving 5,000 amperes and even this limit may shortly require to be increased. A new type of potentiometer specially arranged for heavy current measurements has been designed by Mr. Melsom, permitting the necessary accuracy to be reached with a voltage drop much less than that ordinarily used.

Before proceeding to the description of the new buildings, we might deal with some of the work in another department, where electricity is made use of extensively, namely, that of thermometry. At present the only branches of thermometry dealt with at Bushey are the specially low or high-range thermometers, those of especial accuracy of ordinary ranges, and pyrometers of all types. The more ordinary types of meteorological, clinical and other thermometers are verified at the Kew Observatory Department to the number of about 25,000 annually. A visitor to the thermometric laboratory might well be excused if he imagined himself in the electricity department, so numerous are the electrical appliances installed. For attainment of steady high temperatures a special electric heating equipment is provided, fed from a battery reserved for the purpose. This is now arranged so that, for example, a carbon tube furnace may be heated to 2,500° C. by a current of 800 amperes at 12 volts, or a small arc or resistance furnace run at 100 volts with cur-



Temporary High-current Equipment (Old Building). Showing water-tube resistances and ammeter shunt-testing arrangements.



The General Electrical Laboratory in the Old Building.

rents up to 150 amperes. In addition, the 250 and 500-volt mains of the Twickenham and Teddington Supply Co. are available, and by means of a specially arranged regulating resistance, consisting of a bank of 250-volt lamps, currents from ·1 ampere upwards at either voltage may be obtained at will, for working the furnaces of the new solid electrolyte type, recently employed by Dr. Harker for his redetermination of the melting point of platinum. An equipment has just been completed for making these furnaces on a much larger scale, and it is hoped that by their aid the Violle standard of light may be realised in the photometric department. A potentiometer for thermo-couple measurements, the gas-thermometer presented by Sir Andrew Noble, and the furnaces used in the testing of the Fery radiation pyrometer up to 2,000° C. are features of the larger room, and in the inner room is the new Moissan furnace recently obtained from Messrs. Marryat & Place, shown on the left of our illustration of this room. Leads to the power supply for adequately working this furnace are not yet available. For most experiments, 400-500 amperes at about 100 volts suffices, but the reduction of some of the more difficultly fusible oxides, as carried out by Moissan, would require more nearly double this energy.

We now turn to the new buildings, which have just been completed and are to be opened on Monday. Work on them was begun in the summer of 1905. They have been designed to accommodate the electro-technical and photometric work of the laboratory in a set of spacious rooms which as far as can be seen will meet all the requirements of standardisation and research work.

Our illustration shows a general exterior view from the south-western corner. It will be seen from this that in the main bays the North Light saw-tooth construction of roof has been adopted, securing a good diffused illumination of the interior throughout the whole day. This portion of the building consists of two 25-ft. spans each 120 ft. long, with an additional 20-ft. span for office, workshop and store accommodation.

(*To be continued.*)

LIGHTING and POWER NOTES.

(*Concluded from page* 1002.)

Exeter.—The Lighting and Electricity Committees have recommended the T.C. to substitute electric lamps for a large number of gas lamps.

Govan.—The result of the past year's working of the burgh electricity undertaking has resulted in a net profit of £1,611, which has been placed to reserve, bringing that fund up to £2,000. The total income was £14,034 and the gross profit £7,681; £3,545 was set aside to interest and £2,366 to sinking fund charges.

Grimsby.—The T.C. has approved of the recommendation of the E.L. Committee to apply to the B. of T. for a prov. order to extend the area of supply so as to include Immingham and other parishes.

Hastings.—The T.C. on June 15th decided to convert a large number of arc and other lamps to Oliver Oriflamme arcs at a cost of £2,133, which is to be met out of the rates by three equal annual instalments. The new lamps, it is estimated, will effect an annual saving of £1,311.

Houghton-le-Spring.—The Council has acceded to the request of the Durham Collieries Electric Power Co. to place overhead electric wires over several public roads and footpaths in the district on the way to Hetton-le-Hole and South Hetton.

Huddersfield.—With a view to the development of motive power, new charges and conditions have been agreed upon by the Electricity Committee. The new arrangement will come into operation on July 1st next.

Ilford.—Additional public electric lighting is to be carried out at a cost of £507, which will effect a saving over the cost of gas lamps.

The price of energy to the tramway department has been reduced to 1¼d. per unit.

Leyland.—The B. of T. has deferred consideration of the revocation of the E.L. order for a year from June 23rd.

London.—Bermondsey.—Both the London Electric Supply Corporation and the County of London Electric Supply Co. have made offers to the B.C. to supply energy for public lighting at a less cost than the Council is paying now by running its own undertaking. The latter company also offered to take over the Council's undertaking altogether. The Council has replied that it is doing better by utilising its own generating plant, and further, that it has not the slightest intention of leasing the undertaking to any company.

Fulham.—The Finance Committee of the B.C. reported on Tuesday that the borough treasurer had submitted a statement showing the financial position of the borough for the year ending March 31st, 1906. The Committee made the following remarks with regard to the E.L. undertaking: "The electric lighting scheme must be considered to have closed in a satisfactory manner. To balance the account a transfer has been made from the general rate of £402; but it must not be forgotten that the Council in April, 1905, reduced the price of energy from 5d. to 3½d. per unit; and although an optimistic view was then taken as to the expected increase in the sale, it has not been found possible to effect the larger income anticipated."

When shutting down No. 2 engine on June 5th, water was sucked through into the cylinder, causing the engine bed to crack at the front, some 2 ft. away from the cylinder. The two admission valves of the cylinder were also broken.

Marylebone.—According to a report issued by the Electric Supply Committee on Tuesday, the old plant was sold in 26 lots, and the total amount realised was between £4,000 and £5,000. Everything was sold except the switchgear, the tenders for which were not considered sufficiently high. The total amount paid in commission to the consulting engineer to date is £15,464.

Shoreditch.—At the meeting of the Borough Council on Tuesday, it was decided to purchase meters and demand indicators to meet the requirements of the ensuing year at an estimated cost of £250. The L.C.C. has asked whether there is any immediate necessity for the B.C. to provide extensions of plant, and the borough electrical engineer has reported that during last winter the whole of the generating plant at both stations was running at one time to cope with the demand, and that additional plant, which is on order, is required.

Stepney.—The B.C. is to apply to the L.C.C. for a loan of £10,500 for mains extensions.

Longton.—A L.G.B. inquiry was held on June 12th into the application of the T.C. for a loan of £3,500 for extending the E.L. mains in the compulsory area. There was no opposition, but £50 in respect of meters was eliminated from the loan.

Louth.—The B. of T. has asked the T.C. for its reasons why the revocation of the prov. order for E.L. should be postponed.

Manchester.—A detailed report showing the position and progress of the Manchester electricity undertaking was considered by the Electricity Committee of the City Council at its meeting on Friday last. The net result of the past year's working is a surplus of £16,219 (against £4,544 in the previous year), which will be carried to the reserve fund. This fund now stands at £20,387. The revenue account shows sales of energy for lighting and power £197,903, against £182,560 in 1905; for traction £128,570, against £117,590; and for public lighting £493, as compared with £675 last year. The extremely small amount under the latter head is explained by the fact that the Lighting Committee of the Corporation still clings to incandescent gas lighting for the city streets, except in one or two special places. Other items of the year's income amount to £2,233, making the total £329,199, as against £302,200 in 1905. The working expenditure is stated at £181,118, against £174,320 last year. This includes a sum of £40,000 set aside for future renewals, or £15,000 more than in the previous year. The gross profit amounts to £148,081, against £127,880 in 1905. From this gross amount deductions are made for interest, sinking fund and repayment of loans amounting to £131,862, leaving the net surplus for the year £16,219. A sum of £34,836 is carried forward to next year. During the year the means for distributing energy have been greatly increased by extensions at the Dickinson Street and Stuart Street generating stations, in order to satisfy the increasing demand for lighting and power. The total output of electricity from the three generating stations during the year amounted to 55,025,966 units as compared with 47,170,721 units in the previous 12 months, an increase of 16·6 per cent. The quantity measured and accounted for during the same time was 44,292,725 units, showing a difference of 10,733,241 units, or 19 5 per cent., being the quantity used for distribution or otherwise not accounted for. The corresponding percentage in the previous year was 21·6. The total length of main conductors laid at March 31st, 1906, equalled 302 miles 1,522 yards, being 10 miles 1,357 yards more than at March 31st, 1905. In a report to the Committee, the chief engineer (Mr. S. L. Pearce) mentions that, as regards street lighting, some little progress has been made. The Gorton Urban District Council contracted for the lighting of several main roads, and 41 Gilbert arc lamps have been installed of similar type to some used in the city; the results have given satisfaction. As regards the city itself, no further progress can be recorded. Meanwhile, experiments and tests are being conducted on all the modern types of "flame" arc lamps, and valuable information is being obtained. As to the cost of production, Mr. Pearce says, "Quantity used in distribution, or unaccounted for," stood this year at 19·51 per cent. as against 21·60 in the preceding year. This reduction was accounted for by the use of larger and more efficient sub-station machinery and by the sub-stations becoming better loaded. It was of necessity a

high figure owing to the number of three-phase sub-stations, and had, therefore, a tendency to make the costs of production per unit sold appear more unfavourable than they otherwise would be. However, as the still larger and more efficient converter sets in the various sub-stations come into use, the figure for "units unaccounted for or lost in distribution" is likely to fall slightly lower. A substantial improvement has taken place in the works costs, the largest item being the reduction in the repairs and maintenance costs. Although 12d. has been knocked off the works costs, they are still at a figure which leaves much room for further improvement. The prospects of the undertaking, Mr. Pearce considers certainly encouraging. A feature of the past year's working has been the number of contracts entered into for large power demands with several firms for additional power requirements. The supply to these works, it is estimated, will increase the output by some seven or eight million units per annum.

Mansfield Woodhouse.—The U.D.C. has received from Mansfield T.C. notice of the latter's intention to apply for a prov. order for E.L. in the Mansfield Woodhouse R.D.

Mexico.—The *Diario* of May 14th contains a copy of a law granting the Yaqui Copper Co. an appropriation of from 6,000 to 12,000 litres of water per second from the River Yaqui, in the district of Ures (Sonora), for the generation of motive power.—*Board of Trade Journal.*

Rathmines (Co. Dublin).—Mr. P. C. Cowan held a L.G.B. inquiry on the 18th inst. into an application by the U.D.C. for a loan of £23,000 for the purpose of extending the E.L. system in the township. It was stated that the principal feature of the present scheme was the extension of the feeder system. There is to be a slight reduction in the rate for private lighting.

Saffron Walden.—Mr. M. Parker, of Dover, has submitted to the T.C. a scheme for the formation of a company for supplying electricity, and the Council has replied that it will not be able to negotiate unless the costs already incurred by the Council in obtaining its E.L. order are paid, future costs guaranteed, and a substantial sum paid on account of costs already incurred.

South America.—Uruguay.—The Government has been asked to authorise an expenditure of 250,000 pesos for new machinery for the electric light station so as to be able to supply energy to the Oriental Tramway Co.

Stourbridge and Tamworth.—The *London Gazette* contains notice of the intention of these two Councils to transfer their prov. orders to the Shropshire, Worcestershire and Staffordshire Electric Power Co. for £200 in the case of Tamworth and £500 in the case of Stourbridge.

Taunton.—The statement of accounts of the municipal undertaking for the past year's working, shows a net profit of £422. The Committee has transferred £401 to the reserve account, and carried the balance forward. Motors for hiring out were purchased out of revenue at a cost of £168.

Topsham.—Mr. A. A. Amos presided at the annual meeting of the local Electric Light Co. on Saturday last. The report stated that the income amounted to £114, and a net balance of £20 remained in hand after expenses were paid, with which it is proposed to commence a reserve fund to allow for depreciation. The chairman said the directors were highly satisfied with the result of the first year's working. At present 53 services had been installed; more were coming on. More capital is to be raised in order to add to the capacity of the plant to meet the demand for public lighting and by private consumers.

Wath.—The U.D.C. has formed a Committee to consider the E.L. question, and to ascertain from the supply company terms for a supply of energy in bulk. The Council possesses its own E.L. order, which was, some time ago, extended for a year.

Yarmouth.—The disposable surplus on the working of the Corporation electricity undertaking for 1905-6 amounts to £4,804, as compared with £3,022 in the previous year. The Committee has recommended that £1,200 be allocated to the rates, £1,500 to a reserve fund, and the balance carried forward. The total revenue for the past year's working was £17,327 compared with £15,196 in the previous year.

TRAMWAY and RAILWAY NOTES.

Argentina.—Mr. A. G. Pruden has applied to the municipalities of Parana, Concordia and Gualeguaychu for a monopoly for 99 years for the construction and working of electric tramways. The applicant asks to be allowed to run the lines in whatever streets suit him. A year is asked in which to present plans, &c. Four per cent. on the gross receipts is offered to the municipalities, but the local Press draws attention to the fact that the would-be concessionaire offers no guarantee whatsoever for the carrying out of the work.

Blackburn.—During the last financial year the Corporation tramways covered 974,031 miles, and carried 9,289,035 passengers, showing a decreased mileage with increased traffic compared with the previous year. The total receipts were £51,629; working expenses, £31,111; the balance was more than absorbed by financial charges, and a deficit of £683 resulted on the year. The result, however, shows very favourably compared with previous years.

Brighton.—The accounts of the Corporation tramways up to the end of March show for the first time a net profit of £1,615; the gross profit was £15,400. The total revenue for the year was over £51,000, exceeding all previous years. More than eleven million passengers were carried, and it is interesting to note that an increased number of passengers has been carried on routes on which the fares have been raised.

Canada.—The Ontario Government has decided to electrify a portion of the Temiskaming and Northern Ontario Railway from North Bay, the starting point to Englehart, a distance of 137 miles. The work will cost $1,000,000, including the cost of electric locomotives. The power is to be developed at a fall known as the Ragged Chute, on the Montreal River, about 9 miles from the mining town of Cobalt, and the development will give 8,000 H.P. It is estimated that the railway will require 5,000 H.P., and the balance will be supplied to private consumers, of which the working mines in the Cobalt district will be the most important, a market for 2,000 H.P. already existing.

Cardiff.—The assessment of the municipal tramways having been increased from £9,800 to £20,000, an appeal was made to the Assessment Committee, with the result that the assessment has been reduced to £15,000.

In order to recover traffic lost through local tramway competition, the Taff Vale Railway Co. has made arrangements for running motor-cars between the Docks and Queen Street and Cathays at similar fares to the tramways—the railway route is practically straight

Continental Notes.—Italy.—According to the *Bollettino delle Finanze* (Rome), the industrial and commercial banking house of Barone Giovanni La Cana has applied to the Italian Minister of Public Works for a concession for the construction and exploitation of a direct railway with electric traction from Rome to Naples, the energy to be obtained from the Volturno. The firm asks for no subsidy; the concession would be for a term of 70 years, and after that time the whole plant would revert to the Government gratuitously. The project has been drawn up by engineer Pivetta, and the length of the line will be 198 kilometres. The terminal station at Rome is to be erected in the Piazza Trevi, with a tunnel under the Piazza Monte Cavallo opening out at Porta S. Giovanni. The station at Naples will be in Piazza dell Municipio, with a tunnel under the Palazzo S. Giacomo, Toledo and Vomero.

Padova.—The poll of the town, taken to decide whether the tramways should be purchased by the Municipality, resulted as follows:—3,096 favourable, 130 against.

Croydon.—The T.C. has accepted a tender of £31 10s. per car for tram advertising, which represents an immediate yearly addition to the income of £1,890, exclusive of that to be derived from the new cars to be purchased.

Darlington.—The accounts and statistics of the Corporation light railways for the year ended March 31st last, have been prepared for presentation to the next meeting of the Council, and they show a total revenue of £10,594 17s., and an expenditure of £7,408 11s., but with £4,217 required for the liquidation of loans, the net loss is £1,030 14s., as against £2,628 13s. last year, nothing being allowed for depreciation in either year. The number of passengers carried has increased largely, but the revenue, owing to the operation of ½d. fares, has not proportionately increased, and the borough electrical engineer points out that the loss will continue under the present system, despite the increase of traffic. Another proposal to abandon ½d. fares will be made at the next meeting of the Council.

Sir J. Clifton Robinson is discussing with the Thornaby Town Council the question of doubling the tram lines between that borough and Middlesbrough, and he is also considering certain proposals for the extension of the Imperial Tramway Co.'s undertakings in the Middlesbrough district.

Dublin.—It is of interest to note that the Dublin United Tramways Co. is building its own cars at the Inchicore depôt. The cars are provided with top-deck covers, and are intended for exhibition traffic.

Great Yarmouth.—The past year's working of the Corporation tramways resulted in an income of £18,329, as compared with £8,736 in 1904-5, when only the Great Yarmouth section was in operation. The working expenses in 1905-6 were £12,400 as compared with £6,348 in 1904-5, the gross profits being £5,928 and £2,388 respectively. Interest, income-tax and sinking fund absorbed £4,460 in 1905-6, leaving a net profit of £1,468. A balance of £475 was brought forward from 1904-5, while, on the other hand, £400 was placed to the reserve, leaving a disposable profit of £1,543. The Tramways Committee recommends that £400 should be applied in reduction of the rates, that £800 should be placed to a renewal fund, and that the balance should be carried forward. The number of passengers carried last year upon the Great Yarmouth section was 2,850,827, and upon the Gorleston section 1,464,012.

Leeds.—On Saturday last one of the Corporation's cars standing near the junction of the Leeds and Bradford systems at Stanningley, was struck by lightning, causing some alarm to the passengers, who, however, were unharmed.

Huddersfield.—The application of the Lepton and Whitley Upper U.D.C. for the Corporation tramway service to be extended to Lepton, has been declined.

A ballot has been taken by the motormen in the employ of the Corporation on the subject of brakes, and the Tramways Committee has appointed a special sub-committee to inquire into the whole question, with power to take such steps to obtain information as it may deem advisable.

The town clerk has been instructed to apply to the B. of T. in the next session of Parliament for a provisional order authorising the extension of the tramways to Crosland Hill.

London.—Lewisham.—The B.C.'s objection to the L.C.C. paving the tramway tracks on the line from High Street to Lee Green with granite instead of wood has been forwarded to the B. of T.

Stoke Newington.—The matters between the B.C. and the L.C.C. as to the electrification of the tramways in High Street and Stamford Hill have been arranged. It is now believed that the work can be commenced next month, so that the lines will be finished in September.

Paddington.—The Works Committee of the B.C. reports that it has arrived at an amicable arrangement with the Metropolitan Electric Tramways Co. as to road widening, which will admit of the electrification of the Harrow Road and Paddington tramways proceeding with every expedition.

L.U.T.—We gather that the London United Tramways Co. has no intention of adopting the suggestion made in an extensively-signed memorial to apply for statutory powers to construct a tramway from Twickenham to Hounslow, *viâ* Whitton.

Luton.—The T.C. has applied to the B. of T. for an extension of time for constructing the tramways.

Manchester.—An arrangement has been made by the Tramways Committee with the Oldham Corporation, which provides for mutual running over the areas of each authority. Oldham cars are to run through to Piccadilly (Manchester), and Manchester cars will run to Waterhead, within the Oldham area. The distance between the extended points is about 8 miles, and the present fares will be charged, each authority taking the earnings within its own area. On the Ashton-under-Lyne route some readjustment of fares is contemplated. The Northenden and Sale projected tramway, it is understood, will not for the present be proceeded with, but in order to meet the public demand for better means of communication, the Manchester Tramways Committee will start a service of motor-omnibuses. The experience of these vehicles on the Palatine Road and Northenden section is said to have been satisfactory. They will also be made to serve temporarily the needs of the Withington, Chorlton-cum-Hardy and Didsbury district.

Ripon.—The City Council has adopted a recommendation approving of the Kirkby Malyead light railway scheme.

Southport.—A curious anomaly in connection with the agitation for the running of Sunday trams at Southport is the fact that, although the Corporation does not allow its cars to run, it has to supply energy for the Tramways Co.'s cars to pass over its system to the various sections outside the borough. As long as the latter company's cars are within the borough, they are compelled to carry passengers free, charging only when they have crossed an imaginary line. It is expected that the Council will be asked to quash the plebiscite taken a year or two ago which decided against the Sunday service.

United States.—Behr Mono-rail System.—Mr. F. B. Behr, who has applied to the New York City authorities for permission to build a high speed mono-rail line from Brooklyn to Coney Island, is making a further application to continue the line over the Williamsburg Bridge into the heart of New York City. He also proposes to construct a mono-rail track over an existing electric surface line.

Erie Railroad.—This railway is contemplating the electrification of 250 miles of suburban lines. The plans are being considered by a special commission of engineers who will report in about six months' time.

New York City.—Plans for two new subways in Seventh and Eighth Avenues have been favourably reported on. In consequence of a fire in the present subway, the Rapid Transit Board has ordered that all new subway cars must be entirely fireproof. Of the cars now in use 500 are copper sheathed, and 300 are of all-steel construction.

The Rapid Transit Board has cross-examined its engineers as to the alleged defects in the East River tunnel, a portion of the roof of which has sagged, as previously reported. Mr. George S. Rice, chief engineer of the board, avers that the trouble has been almost entirely remedied, and that the tunnel between New York and Brooklyn will be completed by next January. Mr. August Belmont has refused to make public the report of Mr. Charles M. Jacob, an English engineer, on this subject.

Pennsylvania Railroad.—The contract for the construction of the new terminal of the Pennsylvania Railroad has been let. Adjacent to the station will be a large electrical power house, covering a space of 161 ft. by 99 ft., and of four stories. The estimated cost of this is £60,000. The new station will be connected by means of tunnels under the North River with Jersey City on the mainland, and trains will run in a subway across New York City and under the East River to connect the Pennsylvania Railroad system with that of the Long Island Railroad.

New Jersey.—The electrical construction of the West Jersey and West Shore division of the Pennsylvania Railroad between Camden (opposite Philadelphia) and Atlantic City, a distance of about 70 miles, is progressing rapidly. The contract for the construction and equipment of this line was let to the General Electric Co. last December. Operation of the line is expected to commence on July 1st. Both third-rail and overhead conductors are to be used. Alternating current for the transmission lines will be generated by three 2,000-kw. Curtis steam turbines at 6,000 volts, and stepped up to 33,000 volts for transmission. At the eight sub-stations rotary converters will deliver direct current to the third rail at 650 volts.

Walsall.—The T.C. has decided to apply to the B. of T. for a loan of £38,144 to defray the cost of reconstructing the electric tramway between Bloxwich and Pleck.

Wednesbury.—The B. of T. has informed the T.C. that as at present advised, it will not be disposed to entertain any application for a further consent to electric traction on certain lines in the town, unless the lines are reconstructed and re-equipped.

Weston-super-Mare.—The local electric supply company has applied to the B. of T. for an extension of time for completing the tramways, and the U.D.C. has decided to raise no opposition.

TELEGRAPH and TELEPHONE NOTES.

American Telephones.—The New York Telephone Co. announces a second reduction of rates, and will institute a system of charging by zones on July 1st. The company is being seriously threatened by new telephone companies, which offer very cheap telephone service if they can secure permission to install their system. The rival companies have been instructing the public as to each other's defects by means of page advertisements in the daily papers.

Australian Telephones.—The Central Postal Bureau intends shortly to introduce a system of secret tests in connection with telephone exchange work. Mr. Hesketh found that in America in most of the large exchanges tests were made periodically of the work of exchange attendants. The tests were introduced in Queensland last May, and the result is claimed to have been that the average time occupied by the exchange to answer calls has been reduced from 8 sec. to 4·68 sec. The recent experiments showed that 80 per cent. of the calls were answered in 5 sec. and 95 per cent. in 8 sec., and that only in regard to 1 call in 100 did the exchange exhaust over 11 sec. in replying.

Bulgarian Telephones.—The British Vice-Consul at Sofia reports that telephonic communication has now been established between Sofia and the principal towns of Bulgaria.

Huddersfield Telephones.—The National Telephone Co. has informed the T.C. that it is prepared to re-construct its system in Huddersfield if the Corporation will give its consent. A sub-committee has been appointed to consider the matter.

Italy.—Complete success has attended the trials of the new telephone line between Losanna and Milan. The experiments were made under working conditions, *viâ* Turin and Berna, a total distance of 450 km. Our contemporary, the *Electrician*, of Milan, for May 25th, states that the line will be opened immediately for public service.

Norway.—According to an Italian contemporary, the Storthing of Norway has accepted a proposal of the Director of Telegraphs of Germany for the laying of a cable between Germany and Norway to unite Cuxhaven and Arendal. The Norwegian Government is to subscribe about 1,500,000 francs towards the cost of the work. It is stated that the telegraphic rate between Norway and Germany will be reduced.

Portsmouth Telephone Accounts.—According to the *Daily Chronicle*, the municipal telephone accounts for the year ending March last show a gross profit of £3,864, and a net balance, which can be devoted to extensions or relief of rates, of £1,849. There are now 2,475 exchanges, which cost an average of £18.

Submarine Telephone Signalling.—The Submarine Signal Co., of New York, has recently given a demonstration to the local press of its system.

The U.S. Government has installed signal bells along the coast in the vicinity of New York Harbour, and is experimenting with the receivers on four large battleships.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1903	
St. Lucia-Martinique	May 7, 1903	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1903	
Cayenne-Pinheiro	Aug. 15, 1903	
Port Arthur-Chifu (Closed)	Mar. 7, 1904	
Tarifa-Tangier	Jan. 18, 1904	
Cayenne-Paramaribo	April 20, 1906	June 18
Landlines.		
Puerto-Barrios	Aug. 25, 1903	
Bachkale-Deliman	Feb. 12, 1906	

CONTRACTS OPEN and CLOSED.

OPEN.

Belgium.—July 6th. The municipal authorities of Brussels are inviting tenders for the supply and erection of 108 arc lamps and for 18,000 pairs of arc lamp carbons.

Edinburgh.—June 25th. Lead-covered cables for the Corporation. See "Official Notices" June 15th.

Erdington.—June 27th. Tramway overhead equipment for the U.D.C. See "Official Notices" June 8th.

L.C.C.—July 10th. High and low tension cables for the tramways. See "Official Notices" to-day.

London.—July 3rd. Tramway car fittings, motors, insulating material, &c., for the L.C.C. See "Official Notices" to-day.

Loughborough.—Stores for the electricity department. See "Official Notices" to-day.

Portsmouth.—June 27th. Water softening plant, tank, piping, &c., for the T.C. See "Official Notices" June 15th.

Rotherham.—June 30th. Cables and meters for one year for the Corporation. See "Official Notices" June 15th.

Roumania.—July 10th. The municipal authorities of Focshani are inviting tenders for the concession for the electric lighting of the town.

Salford.—June 22nd. Four direct-current motors (1, 15 and 40 B.H.P.) for the Royal Technical Institute. See "Official Notices" June 8th.

Twickenham.—July 11th. Electric lighting installation for the U.D.C. sewage disposal and destructor works. See "Official Notices" to-day.

Wallasey.—July 16th. A.C. transformers for the U.D.C. See "Official Notices" June 15th.

CLOSED.

Canada.—Montreal.—The contract for the new power house of the Montreal Light, Heat and Power Co., at Saulanges, has been given to the Canadian White Co., at $416,000.

Toronto.—The Canadian Westinghouse Electric Co., Ltd., of Hamilton, Ontario, has secured the contract to furnish machinery for lighting the mammoth new Traders' Bank Building, Toronto. The machinery will consist of two generators of 200 H.P. each.

France.—The French Post and Telegraph authorities have just placed contracts as follows:—La Compagnie Générale d'Electricité, Paris, 80 tons of bronze wire, $1\frac{1}{16}$ mm. diameter, at 3,450 fr. per ton, and M. Charpentier Page, of Valdore, 10 tons of copper wire.

Hastings.—The T.C. on June 15th accepted the following tenders:—

Babcock & Wilcox, Ltd.—Boiler, £772; superheater for same, £150; ditto for No. 4 boiler, £155.
Joseph Wright & Co.—Berryman patent feed-water heater, £79.
Willans & Robinson, Ltd.—Parallel flow steam turbine (Willans-Parsons), coupled to Dick, Kerr separately excited single-phase type alternator and condensing plant (Mirrlees Watson & Co.), £5,418.
G. & J. Weir, Ltd., Weir direct-acting feed pump, £80.
Ferranti, Ltd., high-tension switchboard, £538.

Leyton.—The U.D.C. received on Tuesday the report of the Electricity Committee on the following tenders and dealt with them thus:—

Car Bodies.

Hurst, Nelson & Co.	£16,400
Milnes, Voss & Co.	12,240
" " .. (amended tender) (accepted)	12,400
Brush Electrical Engineering Co.	12,600
Dick, Kerr & Co.	13,960
British Thomson-Houston Co.	12,600

Radial Axle Trucks.

Brush Electrical Engineering Co.	£3,715
" " (alternative tender for 40 cars)	27,368
British Thomson-Houston Co.	3,715
Peckham Engineering Co.	3,848
Mountain & Gibson, Ltd. .. .. (accepted)	3,667

Electrical Equipment for, and Assembling of, Cars.

Raworth's Traction Patents, Ltd.	£15,939
Brush Electrical Engineering Co.	11,853
British Thomson-Houston Co.	10,893
Dick, Kerr & Co.	12,238
British Westinghouse Co. .. .. (accepted)	11,213

London.—Marylebone.—The B.C. has received the following tenders for battery charging boosters, switchboards and accessories for the Rathbone Place battery:—

Lancashire Dynamo Co.	(accepted)	£2,557 10
Siemens Bros. & Co.		3,330 0

Islington.—The B.C. Lighting Committee has provisionally accepted the following tenders for the supply of bituminous slack coal for the electricity undertaking:—

Phillips & Co., Ltd., 5,000 tons, price at pit's mouth, 3s. 3d., price delivered at works 10s. 3d.; 1,500 tons, 4s. 8d. and 10s. 9d.; 1,500 tons, 2s. 11d. and 10s.; 2,000 tons, 2s. 6d. and 9s. 7d.
Blackmore & Co., Ltd., 2,000 tons, 1s. 8d. and 7s. 8d.
Charrington, Sells, Dale & Co., 2,000 tons, 4s. and 9s. 10d.

Fulham.—The B.C. has accepted the following tenders:—

Ferranti, Ltd.—High-tension gear, £244 10s.
J. Fowler & Co., Ltd.—Low-tension gear, £186.
British Westinghouse Co.—Transformers, £353.

The Council has also placed an order with the British Westinghouse Co. for 300 meters to be supplied during the ensuing year, at £2 for 5 ampere-meters, and £2 2s. for 10 ampere-meters.

Manchester.—Messrs. Sewell & Varley, of Manchester, have secured the contract for the complete electrical installation at the new Manchester Stock Exchange.

Scunthorpe.—The U.D.C. has accepted the tender of Messrs. D. Adamson & Co. for the supply of a boiler for the electric plant at the gasworks, at £445.

Wallasey.—In a "Business Notice" last week we mentioned that the U.D.C.'s contract for alternating current meters had been placed with the British Thomson-Houston Co. We learn that the contract was divided between that company and Messrs. Ferranti, Ltd. We have pleasure in making this amplification.

FORTHCOMING EVENTS.

To-day's Events (Friday, June 22nd).—At 5 p.m. Physical Society. Mr. A. A. Campbell Swinton on "The Effect of Radium in Facilitating the Visible Electric Discharge in Vacuo"; Mr. A. O. Allen "A Comparison Between the Peltier Effect and other Reversible Heat Effects"; Mr. T. A. Vaughton "The Effect of the Electric Spark on the Activity of Metals"; Dr. P. E. Shaw on the "Dielectric Strength of Thin Liquid Films"; Dr. W. H. Eccles "The Effect of Electrical Oscillations on Iron in a Magnetic Field."

Saturday, June 23rd.—Foreign visitors arriving. The programme of arrangements for the visits, &c., in London and the provinces during the next fortnight will be found on page 877 of our June 1st issue.

NOTES.

The High School of Technology at Kensington.—The Council of the Association of Teachers in Technical Institutes has passed a resolution welcoming the establishment of a technological high school at South Kensington on the lines laid down in the Departmental Committee's report, but suggesting that the following points be considered before the report is embodied in a concrete scheme:—

"1. The work of the Institution should be confined to technical investigation, research and post graduate studies as defined in Sec. 88 of the Committee's report, and no training preliminary to the true work of the Institution should be undertaken in the new college. Some of the highly specialised departments should be situated at more convenient centres in the provinces, and full use should be made of the staff and equipment already existing in such towns as Manchester, Leeds, Sheffield, Newcastle-on-Tyne, &c. There should be due co-ordination between the work of existing technical institutions and that of the now suggested Institution, especially in regard to the earlier training of students to fit them to profit fully by the advantages offered in the highly specialised departments of the school at South Kensington and elsewhere.

"2. The conditions of admission should be so framed that the minimum age of students entering the school should be 19, and all students should be required to give evidence of previous satisfactory training for three years after having reached the standard of general education marked by University matriculation. This can be easily secured if a suitable scheme of co-ordination work be arranged amongst the Technical Institutions. An honours degree in science of a British or Colonial University should also be accepted as qualifying for admission.

"3. Owing to the large amount of public money to be utilised in the establishment and maintenance of the new Institution, there should be a greater element of public control on the governing body than is suggested in Sec. 95 of the Committee's report. Further, there should be representatives from associations connected with technical education, in order that the continuity of a student's work can be secured. This Association endorses the recommendation of the majority of the Departmental Committee that the governing body should be appointed at once and in the first instance for a period of five years."

The Association is of opinion that the new Institution should be permanently independent of University control.

Electrical Contractors and English Cables.—The *Daily Telegraph* says that at the annual meeting in Leeds on Saturday of the Electrical Contractors' Association of the United Kingdom, which now numbers 250 members, Mr. E. L. Berry (late chairman of the London section) said an agreement had been made by the Cablemakers' Association with the main idea of inducing the members of the Electrical Contractors' Association to use English-made cables pure and simple.

Accidents Caused by Electricity in Switzerland.—The Lugano correspondent of the *Times* Engineering Supplement says:—"The annual return for last year shows that throughout the whole of Switzerland there were 30 cases of accidents by electricity, of which 21 were fatal. Among the victims seven belonged to the staff directly engaged in this branch, 16 to those employed in other departments of the works, while seven were strangers. The workmen immediately concerned with the electrical apparatus suffered most severely, and the statistics indicate that the majority of the accidents were due to the extreme carelessness of these workpeople and to the neglect of the stringent regulations enforced on their behalf. No less than 62 per cent. of the cases were caused by imprudence and want of caution. What took place in respect of two of the strangers would appear to show that the directions concerning the mode of averting injuries by fallen wires are not yet sufficiently known to the public. People are too liable to forget that the mere approach to a cable conveying a high-tension current which has fallen to the ground is dangerous. Six accidents (21 per cent.) were caused by low-tension currents, not exceeding 250 volts; three (11 per cent.) by medium currents, from 250 to 1,000 volts; while 20 accidents (68 per cent.) were due to high-tension currents exceeding 1,000 volts. The fact that a very feeble pressure may occasion severe injuries is shown by the loss of a life owing to a current of 2 amperes at 120 volts, while at the opposite extreme a man survived a shock caused by a current with a tension of 20,000 volts."

Electric Shock Fatality.—Mr. Tek Seng while up a ladder painting a high tension transmission pole near the Kuala Lumpur Central Electric Power Station came into touch with the wires, and fell dead. His Towkay had warned him of his danger. This particular pole was the only one in the yard carrying high tension wires.

The *Western Mail* says that on Tuesday last week, at the Pyle and Blaina Works, Blaina, Edwin Rees (20) met his death by electric shock. Rees was employed to drive a "pusher" in the coke yard driven by electric power. No one was near when the accident happened, but a fellow workman observed that Rees was thrown rather violently from the engine towards the door of the engine room, uttering a terrible scream. Assistance was obtained, and attempts were made to restore deceased, who was gasping and writhing. The breathing and struggling gradually ceased, and he died about 15 minutes after receiving the shock. The Pyle and Blaina Works quite recently laid down a large electric power plant and have quite remodelled their works. Practically everything on the works is electrically propelled. The engine that deceased was in charge of was used in the coke yard to push the coke out of the ovens. Deceased's hand was badly burnt.

At Edinburgh on 14th inst., an inquiry was held concerning the death of Alexander Munro, coal-cutter attendant, showed that while he had been working an electric coal-cutting machine in the Emily pit, belonging to the Arniston Coal Co., he had taken hold of a wire haulage rope for the purpose of adjusting it. He immediately afterwards shouted for the current to be switched off, as there was something wrong with him. He collapsed, and despite the fact that artificial respiration was carried on for over an hour the man never recovered. It was the opinion of the doctor who made the post-mortem examination that death was due to severe shock. A formal verdict to that effect was returned.

Electric Smelting in Canada. — In a preliminary report on the experiments made at Saulte Sainte Marie under Government auspices in smelting Canadian iron ores by electro-thermic processes, Dr. Haanel, Superintendent of Mines, states the cost of production per ton of pig-iron by electric process to be $10.69, and that the estimated cost of a 10,000-H.P. plant producing 120 tons of pig-iron per day of 24 hours would be $700,000.

Cast-Iron for Valve Bodies.—A recent report of the Board of Trade upon the explosion or fracture of a steam stop valve on a boiler at Southend electricity station is only another reminder of the unsuitability of cast-iron as a material for valve bodies. The report states that the fracture was due to a water hammer shock at a considerable distance from the valve body which broke, supplemented by an initial stress in the valve body. Since steam pipes are almost always in a state of considerable stress, no surprise need be felt at the many failures of valve bodies and cast-iron junction pieces. These, as well as straight lengths of pipe, ought to be of mild steel with a greater range of elasticity than cast-iron. Indeed, if any part of a length of steam pipe ought to be of cast-iron, it is the straight lengths and not the junction pieces. These are made of cast-iron, solely because of expense and difficulty, but pressed steel valve bodies and junction pieces of mild steel are now on the market, we believe, and there should be no need for further risks to be taken.

Moore v. City of London Electric Lighting Co.—In our leader pages we refer to this case. We should add that the Judge put three questions to the jury, viz.:—

1. Ought plaintiff to have asked defendants to move their cables? Answer.—Yes.
2. Were defendants' cables sufficiently protected? Answer.—No.
3. Could plaintiff, by taking another route, have avoided defendants' cables? Answer.—Yes.

These answers meant a verdict for the defendants, and judgment was accordingly given for the City of London Co.

Gas.—A woman and two young children were suffocated by gas at Uxbridge on Sunday night.

Institution Notes.—Royal Society.—The following papers, among others, were down to be read at yesterday's meeting:—"The Action of Radium and Certain other Salts on Gelatin," by W. A. D. Rudge. (Communicated by Prof. J. J. Thomson); "On the Electric Inductive Capacities of Dry Paper, and of solid Cellulose," by A. Campbell. (Communicated by Dr. R. T. Glazebrook.)

Institution of Mining Engineers.—On Thursday and Friday last week, the forty-fourth general meeting of the Institution was held in London at Burlington House. Among the list of papers were the following:—

Papers Read, or Taken as Read.

"The Commercial Possibilities of Electric Winding for Main Shafts and Auxiliary Work." By Mr. W. C. Mountain.
"Electrically-driven Air Compressors, combined with the Working of the Ingersoll-Sergeant Heading Machines, and the subsequent Working of the Busty Seam." By Mr. A. Thompson.
"A Rateau Exhaust Steam-driven Three-Phase Haulage Plant." By Mr. William Maurice.
"The Capacity Current and its Effect on Leakage Indications on Three-Phase Electrical Power Service." By Mr. S. F. Walker.

Papers Open for Discussion.

"Electric Winding Engines at the Exhibition of the North of France, Arras, Pas-de-Calais." By Mr. Ed. Lozé.
"Electrical Power Distribution." By Mr. R. L. Gamlen.
"Earth in Collieries, with Reference to the 'Special Rules for the Installation and Use of Electricity.'" By Mr. S. F. Walker.

Visits were also paid to the Royal Observatory, the L.C.C. tramways generating station at Greenwich and the Rotherhithe Tunnel works.

Transformer Station Gardens.—On Saturday last there took place the public opening of the gardens which have been laid out on the top of a large transformer station which has been erected mainly underground at Duke Street, Grosvenor Square, by the Westminster Electric Supply Corporation. At present only half of the building is occupied with electrical machinery, the rest being used by the Supply Corporation's employés as a rifle range.

The L.C.C. Electric Supply Bill.—In connection with the proceedings which are reported on another page, we learn that on Wednesday the members of the Committee, with the exception of Mr. Richard Bell, visited the L.C.C. generating station at Greenwich, leaving Westminster Pier on the L.C.C. steamboat *Colechurch* at 12 o'clock, and returning at 4 o'clock. The party was accompanied by Mr. A. L. C. Fell and other officials of the Council. It had been suggested that the Committee should, on the return journey, visit the Bankside station, but our representative learnt that this suggestion was not carried out, the Greenwich station being the only place visited.

The Greenwich Observatory.—Yesterday in the House of Lords, Lord Ellenborough was to call attention to the action of the London County Council in building furnaces and tall chimneys nearly due north of Greenwich Observatory, and in using engines which cause some of the astronomical instruments to vibrate in such a manner as to destroy all possibility of accurate observation, and was to ask the Government if they would apply to Parliament for power to prevent the Royal Observatory from being shaken or smoked out either at present or at any future time.

Appointments Vacant. — Junior demonstrator for Birmingham Municipal Technical School (£80); working electrical engineer for the Scunthorpe U.D.C.; electrical engineer for Heston and Isleworth U.D.C. (£300); general assistant for the Bexley U.D.C. Tramways staff. See our "Official Notices" for particulars.

Significant!—During the discussion on some of the M.E.A. papers, considerable importance was attached to the necessity of cheapening electricity supply, in order to meet on something like equal terms the very real competition of gas. Stress was also laid on the fact that the station engineer should not only be technical, but possess business qualifications—in other words, that he should be what is now known as a commercial engineer.

The gas people are equally alive to the situation, as may be gathered from the following extract from a speech delivered on Tuesday by the President of the Institution of Gas Engineers:—

"In those towns where local affairs were directed by capable, practical men, and the gas and other municipal undertakings were managed upon sound business lines, municipal ownership was a decided advantage to the community.

"With regard to the competition of electricity with gas, it might be that some epoch-making discovery—as important to the electric lighting industry as was the Welsbach mantle to gas—might entirely revolutionise the electricity supply. In that case gas undertakings which could not supply cheap gas would be heavily handicapped."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.

Central Station Engineers.—On Thursday last week the Motherwell Electricity Works staff and workmen presented Mr. Trott, senior engineer-in-charge, with a portmanteau, as he is

made cables pure and simple.

leaving for New Zealand. In making the presentation, Mr. Williams, the burgh electrical engineer, spoke in eulogistic terms of Mr. Trott's three and a half years' service with the department. Mr. Trott suitably replied. A smoking concert followed.

The Bournemouth T.C. has increased the salary of Mr. C. H. WOODWARD, electrician at the generating station, from £125 to £140 per annum, this to cover all overtime required.

The Yarmouth T.C. has increased the salary of Mr. BRYANT, electrical engineer, from £300 to £350, rising by £25 a year to £400.

The staff at the Hoylake Electricity Works on June 14th presented a furnished trayelling bag to Mr. H. G. MCHAFFIE, electrical engineer, who is leaving to take an appointment with the Para Electric Railways and Lighting Co., Brazil.

On May 29th, at Devonport, Mr. W. FRED STAMP, chief assistant engineer at the Devonport Council Electricity Works, was married to Mabel, eldest daughter of G. Puleston Clarke, Esq., of Devonport.

The *Southend Standard* says that Mr. ROBERT BIRKETT has resigned the position of borough electrical engineer of that town.

General.—Mr. A. C. EBORALL is this month resigning his seat on the board of Messrs. Witting Bros. & Eborall, and taking up the position of managing director of Messrs. Brown, Boveri & Co., Ltd. Some further particulars regarding the change appear in "Trade Announcements" in our "Business Notices" to-day. It may be interesting to add that Mr. Eborall is not new to the business of Messrs. Brown, Boveri & Co., for he was with them on their staff in Baden 10 years ago.

Mr. S. J. EBBUTT, who recently resigned his position as manager of the telephone, telegraph and signalling department, Birmingham branch (and previously Newcastle-on-Tyne), of the General Electric Co., Ltd., has now joined the staff of Messrs. Eckstein, Heap & Co., Chapel Walks, Cross Street, Manchester.

On the 12th inst. the staff of the Great Northern and City Railway Co. presented an antique oak bureau to Mr. JOHN SEVERS, chief outside engineer, on the occasion of his marriage. The presentation took place at the chief office of the company, and was made by Mr. Brousson, chief engineer and manager, who mentioned the esteem in which Mr. Severs is held by the staff. Mr. Severs suitably replied.

Mr. W. E. MILNS, an assistant engineer of the Newcastle Electric Supply Co., has obtained the appointment of commercial assistant in the Birmingham Corporation electric supply department.

Mr. E. C. AMOS, consulting engineer and engineers' representative, has removed to 22, Walbrook, London, E.C.

The Council of the Society of Arts have awarded the Society's Silver Medal to the following readers of papers during the session just completed:—Mr. Leon Gaster, A.M.I.E.E., "Progress in Electric Lighting"; Captain G. S. C. Swinton, "London Traffic"; Mr. J. B. Millett, "Submarine Signalling."

Mr. WALTER WHITE, of Stratford-on-Avon and Croydon, has been appointed electrician to the Gold Coast Government Railway, and sails for the colony on June 30th.

Mr. PERCY R. TODD, first vice-president of the New York, New Haven and Hartford R.R., is reported to have become the head of a large electrical railway enterprise in Canada, to parallel a portion of the Grand Trunk Railway. Mr. Todd is at present in Europe.

Mr. JAMES WALSH has resigned his position with the Caucasus Copper Co., Dzansoul, Batoum, South Russia, and will shortly be leaving for England. Mr. Walsh has been electrical engineer of the above company for the past two and a half years, and was formerly with the Corlett Electrical Engineering Co., Wigan.

Mr. ALFRED S. L. BARNES has been appointed, on six months' probation, from the position of assistant electrical engineer to that of electrical engineer to the Sanitary Commissioners of Gibraltar.

At Swansea, on Tuesday, Mr. F. BROOME, chief clerk in the Swansea Corporation Electricity Department, was married to Miss D. King. Amongst numerous presents were a massive onyx clock and a pair of carved bronzes, presented by the staff and workmen of the electricity department.

We regret to learn that Sir W. H. Preece is again ill. He was thus prevented from attending the M.E.A. meeting on Wednesday.

Obituary.—A daily paper announces the death of Mr. T. P. GUNYON, an electrical engineer under the London County Council.

The death took place on June 12th, at St. Anne's, of Mr. MALCOLM GUTHRIE, managing director of the Blackpool, St. Anne's and Lytham Electric Tramways. Mr. Guthrie was 70 years of age.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Hall's Transmission Gear Syndicate, Ltd. (83,191).—This company's annual return was filed on May 11th, when 34,922 shares had been taken up out of a nominal capital of £50,000 in £1 shares, £34,922 being considered as paid. Mortgages and charges: £9,800.

Issue on May 31st of £600 5 per cent. debentures, part of series created February 9th, 1905, to secure £20,000, charged on certain freehold land in St. Mary Stoke, Ipswich, certain patents and rights, and the company's undertaking and property, present and future, except unpaid capital. Trustees: F. Barker, Chatsworth Lodge, Grove Park, Chiswick; and H. Wade, 111, Hatton Garden, E.C. Previously issued of same series: £9,950.

Thomas Parker, Ltd. (40,973).—Issue on May 31st of £5,000 4 per cent. debentures, part of series created June 23rd, 1898, to secure £75,000, charged on the company's undertaking and property, present and future. No trustees. Previously issued of same series: £60,000.

Sir Hiram Maxim Electrical Co., Ltd. (London) (84,426).—Issue on May 25th of £4,500 5 per cent. debentures, part of series created May 16th, 1906, to secure £10,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. No previous issue of same series.

National Provincial Electricity Corporation, Ltd. (76,843).—Particulars of £5,000 debentures, created May 16th, 1906, charged on the company's undertaking and property, present and future, including uncalled capital, have been filed pursuant to Sec. 14 (4) of the Companies Act, 1900. No trustees.

Madras Electric Tramways (1904), Ltd. (80,361).—This company's annual return was filed on April 24th, when 71,007 ordinary shares had been taken up out of a nominal capital of £100,000 in 25,000 preference and 75,000 ordinary shares of £1 each. £1 per share has been called up on 1,007, resulting in the receipt of £1,007. £70,000 shares are considered as fully paid. Mortgages and charges: £50,000.

Telephone Co. of Egypt, Ltd. (17,824).—This company's annual return was filed on April 26th, when 24,000 preference and 4,000 deferred shares had been taken up out of a nominal capital of £200,000 in 36,000 preference, and 4,000 deferred shares of £5 each. £5 per share has been called up on 12,000 preference, resulting in the receipt of £60,000. £80,000 is considered as paid on 12,000 preference, and 4,000 deferred. Mortgages and charges: £100,000.

Loughborough and District Electric Traction Syndicate, Ltd. (64,124).—This company's annual return was filed on May 23rd, when the entire capital of £1,000 in 100 shares of £10 each had been taken up and paid for in full. Mortgages and charges: Nil.

CITY NOTES.

India-Rubber, Gutta-Percha and Telegraph Works Co.

THE half-yearly meeting was held on Tuesday at the offices, 106, Cannon Street, E.C., Major Leonard Darwin presiding.

The CHAIRMAN said that those half-yearly meetings were called together to sanction the payment of an interim dividend only, no account of the report from the directors being presented. This was because, although they were able to form some idea as to the results of the trading during the first six months of the financial year, they were unable to report from exact knowledge. That information could only be obtained when stock was taken and the company's books were made up. During the six months just elapsed the prices of raw materials had maintained their high standard, and competition prevented them from taking orders at what were formerly considered fair prices. The only way they had been able to meet those drawbacks in recent years had been to increase their turnover, and that they had been successful in doing on the average of years, although the high selling prices forced upon them by the advance in the value of the raw material had somewhat checked that increase for the last three years. He could not well lay before the meeting where the increases came from and where the decreases occurred, as the making public of such a statement would be giving their competitors more information as to their affairs than the board thought they should possess. He might say, however, that taking things as a whole, the board had no reason to be greatly dissatisfied, and did not hesitate to recommend the payment of an interim dividend. It might be remembered that at the general meeting in December the shareholders were informed that the company had in hand the manufacture and laying of a cable between Manila and Shanghai, some 1,300 miles in length. He had to report that their cable steamer *Silvertown*, which was charged with the laying, completed her work without the slightest hitch, and was expected to arrive in the English Channel towards the end of the month. That vessel on her voyage home grounded on a shoal near Suez, and again in the Suez Canal. A delay of a few days was caused, but the vessel was practically uninjured, and was now on her voyage to Holland with a cargo of some 4,000 tons of rice, which she shipped at Saigon. The *Buccaneer* had had successful employment on one or two occasions, and the skill of their staff and the convenience of the vessel had gained for her an excellent reputation for executing quick and effective cable repairs. The board had spent a not inconsiderable amount on their vessels during the year, so as to keep them in a very efficient state. The work in connection with the electric power station they had been erecting at their works in France was well in hand, the machinery was on order, and the foundation of the new building was being proceeded with. At the Silvertown Works things were in a satisfactory state. Their £300,000 of 4 per cent. debentures, and £100,000 4½ per cent. debentures fell due for repayment on March 25th last, and the board, on advice, decided to make a fresh issue reducing the interest payable on the second of those by ½ per cent. That operation was completed without difficulty, although the state of the money market at the time of issue was a little unsettled. In conclusion, he moved "That the distribution of an interim dividend of 2½ per cent., or 5s. per share, payable, free of income-tax, on the 21st inst. to the shareholders on the company's register at to-day's date, be approved."

The motion was seconded by Mr. GEO. HENDERSON, and carried.

Electricity Supply Company for Spain.

THE directors' report for 1905 states that the rent of Ptas. 1,100,000, receivable under the lease of the company's undertaking in Madrid to the Compania General Madrilena de Electricidad, has been regularly paid to the bankers in Madrid. Including interest on

deposits and other receipts, the gross revenue for the year amounted to £33,382. After deducting debenture interest, interest on loans, income-tax and all other charges, amounting to £17,802, there remains a net sum of £15,580. Of this £14,142 has been applied to the redemption of debentures and £500 to reserve for contingencies, leaving £938, which, with £6,541 brought forward from last year, makes a balance on the profit and loss account of £7,479, which the directors propose to carry forward. The shareholders have again approved the directors' policy of devoting practically the whole of year's profits to the redemption of the debentures, and this year the sum of £14,142 has been set aside for this purpose. In view, however, of the strengthened position of the company, the shareholders may decide to take in the near future the dividends to which they are entitled.

R. Waygood & Co.

Mr. H. C. Walker presided at the meeting held at Cannon Street Hotel on the 18th inst. In the course of his speech on the work done during the year, the chairman mentioned the following contracts for electric lifts:—Two passenger lifts for Bournemouth Corporation, to travel from the sands to top of cliffs; one passenger lift for Lord Rosebery; one passenger lift for Lord Newton; 21 electric lifts for Victoria station extension, South-Eastern and Chatham Railway; 14 electric lifts for Caledonian Railway station extension, Glasgow; eight electric lifts, St. Bartholomew's Hospital; and four lifts for His Majesty's ship *Cyclops*, building at Sunderland. We had also in hand several electric cranes. They had felt for some time that, though hydraulic power has many advantages for quick-lifting cranes, electricity, at the present low prices for power prevailing in London, was bound to be largely used, and they had designed, and were fitting up, several electric cranes on the river, including some of the big Luffing type. The profits this year showed a small increase, and this, in view of the recently depressed state of the building trade, was highly satisfactory.

Mr. R. Percy Sellon seconded the adoption of the report, and it was carried. The dividend for the year was 9 per cent., that being the figure paid for the last four years.

Birmingham and Midland Tramways Co.

The twenty-second general meeting of this company was held on Thursday of last week at Donington House, Mr. C. S. B. Hilton presiding.

The Chairman, in moving the adoption of the report, said he was pleased to come before them with such a satisfactory one. They would see from it that the gross receipts, including the amount brought forward, totalled £118,344, as against £107,930 for the previous year, but that only included five months' working of the omnibus system, to which he would refer later. After payment of expenses chargeable to revenue, there remained £42,773. The debenture stock and the preference dividend of 5½ per cent. absorbed £23,912, and there was a balance left of £18,866 for the payment of a 5½ per cent. dividend. Coming to the balance-sheet, the capital remained at the same figure as last year. During the year an issue of £750,000 debenture stock was made to pay for new cars, electrical construction and equipment. Sundry creditors had been reduced by £22,000, owing to the issue of debenture stock. With reference to the depreciation reserve fund, they would notice that that stood at the same figure, the directors being of opinion that the item did not require adding to. Seeing that they commenced their year on July 1st, they had paid to the trustees £3,000 towards the redemption of the debenture stock, and that, he thought, would tend to strengthen the company, and from time to time they would add to the depreciation fund for the ordinary purposes of business, so as to hold the strong position they now had. That left a balance of £28,966, as against £31,792, rather less, but notwithstanding that they were paying the same dividend. Coming to the other side of the balance-sheet, the expenditure on the tramway undertaking had been £341,254. The reason of that being so large was because of the recent reconstruction of the lines, new rolling stock, and expenditure on electrical equipment, &c. As regarded their associated companies their shares in them now amounted to £812,847, as against 709,000. They would notice that the supply of current to the traction section showed a large improvement during the past year, and that they had made considerable progress both in the lighting and power section. Their tramway receipts also showed a satisfactory increase. Rates unfortunately always had an upward tendency, and they were this year paying £2,000 more. He was glad to tell them that although they lost the line in Birmingham they had made arrangements with the Corporation of Birmingham for a through service from Dudley right into Birmingham. That would be some compensation to them for losing the Birmingham line, and he thought they must be satisfied with the arrangement. Next year of course they would not have to pay any rent for that line, and it would consequently come off the other side of the accounts, and any deficiency would be more than made up from the improvements in the receipts of other lines. With reference to their omnibus undertaking that had now been in existence for seven months. A new company was formed which took over the Birmingham Motor Express Co. and the Birmingham Tramways Co., and up to the present it had proved satisfactory, but the revenue so far was not worth speaking of. They were looking forward in the future to a great improvement in that branch of the work. They had no option but to go into the omnibus line; it was forced upon them by their competitors, and they had not only to take it up, but to take it up vigorously. Owing to the Corporation of Birmingham taking over their line in Birmingham, they had had to build a new workshop, and to do that they had entered into joint co-operation with other companies in the district, and he thought the arrangement would turn out satisfactorily. Last November they instituted a system of collecting and delivering parcels, and so far it had proved satisfactory, and there was every indication that it would be a valuable asset to the finances of the company. The Rowley tramways had not been as successful as they had hoped, but he thought it was only a matter of time. He thought he need hardly refer to their investments in the Birmingham Tramway Co., but as far as they could ascertain they were very satisfactory. Their investments in the Dudley tramways had also proved satisfactory, and they would in future be the lessees of that company. The actual price of the transfer had been fixed at £32,957 for the tramways within the borough. The arbitrator had reserved his decision with regard to the light railway No. 5 as to the two alternative awards of £16,548 under the Tramways Act, 1870, or £32,576 under the Light Railway Act, 1895. If they got the larger sum, the Dudley Co. could pay off their debt. The South Staffordshire Co. had been going through what he might call a trying time; but they would see from the report that the traffic receipts were satisfactory, and, no doubt, their investments in that company would in the future bring them in good dividends. In conclusion, he was glad to be able to report that their investments in the sub-companies were of a progressive nature. They were making a further sale of 70,000 shares to redeem their loss of the City of Birmingham tramways, and that would, he thought, terminate their financial troubles.

Sir Ernest Spencer seconded the motion, and the report was adopted.

Sao Paulo Tramways, Light and Power Co.—The directors have declared a quarterly dividend of 2 per cent.

Hastings and District Electric Tramways Co.—The report for 1905 says that a portion of the system was opened in July and part in August last. These represented 10·58 route-miles. The power house and sub-station at Beaufort Road are now thoroughly complete, and the whole of the work has been carried out in a most satisfactory manner by the contractors. The line from Bo Peep to Bexhill was opened on April 9th last, considerable delay having occurred in its completion owing to difficulties in settling with the holders of land. The line from Bexhill to Kewhurst is also well forward, and will be finished very shortly. As regards the front line, between the Memorial and Bo Peep, the directors regret that they have vainly endeavoured to persuade the Corporation of Hastings to agree to the laying of this line with the overhead system. They have therefore been compelled to consider the question of some other form of electric traction which would ensure a continuity of service with the other portions of the system; [and they decided to recommend the Dolter surface contact system, which the Corporation finally accepted on May 18th, and no time will now be lost in completing the system.

Prospectus.—*Matale Ceylon Rubber Co.*—This company has this week been offering 15,000 £1 shares to the public. It has acquired rubber and cocoa estates in the Matale, North District of Ceylon. It is proposed to begin tapping the older rubber trees next year. In all there are 16,000 trees.

Stock Exchange Notices.—The Committee have appointed special settling days as under:—

Wednesday, June 27th.—Johnson Phillips.—168,365 vendors' ordinary shares of £1 each, fully paid, Nos. 6,636 to 175,000, and £58,333 vendors' 5 per cent. first mortgage debenture stock.

London Electric Supply Corporation.—Further issue of 10,000 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 60,001 to 70,000.

Thursday, July 5th.—Manx Electric Railway Co.—Scrip (fully paid) for 22,900 5½ per cent. cumulative preference shares, Nos. 301 to 21,635 and 23,436 to 25,000, and £200,000 4½ per cent. first mortgage debenture stock.

And ordered the undermentioned to be quoted in the Official List:—

London Electric Supply Corporation.—Further issue of 10,000 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 60,001 to 70,000.

Stone (J.) & Co.—10,000 vendors' 5 per cent. cumulative preference shares of £10 each, fully paid, Nos. 20,001 to 30,000.

City of London Electric Lighting Co.—The directors have declared the following dividends on account of the distribution for the year ending December 31st, 1906:—

6s. per share, being at the rate of 6 per cent. per annum on the preference shares for the half-year ending June 30th, 1906.

5s. per share, being at the rate of 5 per cent. per annum on the ordinary shares for the half-year ending June 30th, 1906, viz., 2½ per cent. for half year.

The above dividends, less income-tax, will be payable on the 17th prox. The dividends are at the same rate as for the corresponding period of 1905.

Electric and General Investment Co.—Subject to the completion of audit, the directors recommend the following dividend, &c., for the year ended May 31st, 1906:—A dividend of 2s. per share, or 10 per cent. for the year on the ordinary shares; 1s. per share was paid on account in January, 1906, leaving 1s. per share to be now distributed. The trustees for the ordinary shares reserve fund also propose to distribute out of the dividends received 1s. per share. The trustees for the founders' shares reserve fund propose to distribute out of the dividends received £10 per share These payments will be subject to the deduction of income-tax The dividends, &c., will be paid on July 4th.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	*
†Aberdeen	May 26	1,305	— 27	52	69,374	— 180	14·4	..
Ayr	June 9	626	— 34	4	1,033	— 143	8	..
Bath	,, 13	2,187	+ 686	24	17,565	+ 2,670	13	..
Belfast	,, 15	7,388	+2,524	24	74,365	+20,100	40	+ 6½
Birkenhead	,, 17	2,266	+ 49	11	11,842	+ 252	13·5	..
Blackburn	,, 13	2,585	+ 204	11½	12,171	+ 660	13·5	..
Blackpool Corp.	,, 14	4,428	+1,531	11	10,726	+ 1,857	11·87	..
,, —Fleetw'd	,, 16	2,862	+ 840	24	9,162	+ 977	8·25	..
,, —Lytham	,, 14	2,039	+ 870	32	8,283	+ 1,410	7½	..
Bolton	,, 17	5,134	+ 848	11	24,055	+ 1,621	26	+ 1
Bournemouth	,, 13	3,963	+1,207	10½	17,514	+ 5,162	17·4	+ 7½
Bradford	,, 16	11,457	+ 954	11	51,432	+ 2,435	53	..
Brighton	,, 17	2,355	— 46	11	10,698	..	9·5	..
Bristol	,, 15	12,724	+1,134	..	..	..	28·5	..
Brit. Elec. Trac. Co								
Airdrie	June 8	466	+ 68	23	4,996	+ 517	3·65	..
Barrow	,, 8	684	+ 200	,,	5,200	+ 450	5·37	..
‡Birmingham (City)	,, 8	12,511	+ 458	,,	121,661	— 5,712	14·5	..
Birmingham (Mid.)	,, 8	3,423	— 685	,,	32,396	— 8,914	12·25	..
Devonport	,, 8	1,657	+ 132	,,	9,861	— 902	8·85	..
Dudley—Sto'rb'ge	,, 8	2,505	+ 729	,,	18,849	+ 854	21·25	..
Gateshead	,, 8	2,116	+ 234	,,	21,347	+ 1,188	11·25	..
Gravesend, N'fleet	,, 8	624	+ 150	,,	5,032	+ 342	6·5	..
Greenock	,, 8	1,503	— 149	,,	14,179	+ 786	7·25	..
Hartlepool	,, 8	763	+ 241	,,	6,213	+ 620	6·72	..
Leamington	,, 8	521	+ 426	,,	3,497	+ 1,921	3	..
Merthyr	,, 8	485	+ 95	,,	4,365	+ 79	2·9	..
‡Metropolitan	,, 8	8,830	+3,616	,,	72,848	+24,359	22	..
Middleton	,, 8	938	+ 144	,,	7,365	+ 408	8·5	..
Oldham — Ashton	,, 8	1,275	+ 126	,,	12,447	+ 556	9·13	..
Peterborough	,, 8	339	+ 54	,,	2,581	— 103	5·31	..
Potteries	,, 8	3,997	+ 562	,,	40,348	+ 2,661	29	..
Rothesay	,, 8	434	+ 148	,,	2,348	+ 582	2·75	..
Southport	,, 8	978	+ 352	,,	6,374	+ 328	8·17	..
South Staffs.	,, 8	2,664	+ 621	,,	18,442	+ 3,014	13·87	..
Swansea	,, 8	2,004	+ 407	,,	17,752	+ 4,658	5·5	..
Tynemouth	,, 8	770	+ 215	,,	4,636	+ 112	3·75	..
Weston-s-Mare	,, 6	434	+ 197	,,	1,487	+ 152	3	..
Wolverhampton D.	,, 8	1,210	+ 442	,,	9,340	+ 1,173	14·75	..
‡Worcester	,, 8	735	+ 120	,,	5,890	— 379	5·75	..
Yorks. Wool. Dist.	,, 8	2,265	+ 897	,,	19,847	+ 6,287	17	..
Miscellaneous	,, 8	5,090	+ 350	,,	43,896	+ 434	..	..
Burnley	,, 16	2,787	+ 369	23	..	..	7·5	..
Burton-on-Trent	,, 17	679	— 54	11	3,341	— 258	8·5	..
Bury	,, 10	2,357	..	10	10,138	..	10·5	..
†Cardiff	,, 9	2,914	+ 895	10	20,579	+ 313	15·87	..
Carlisle	,, 16	442	— 1	24	4,116	+ 66	..	..
Chatham and Dist.	,, 14	1,606	+ 149	24	14,715	+ 32	10·29	+ ·96
Colchester	Mar. 7	327	— 5	31	5,660	..	7½	+ ½
Cork	June 14	1,178	+ 56	24	10,615	— 210	9·89	..
Croydon	,, 15	3,634	+ 556	2	3,816	+ 557	11·12	+ ·37
Darlington	,, 16	450	+ 12	11	2,309	+ 95	4·8	..
Darwen	,, 16	554	+ 11	11	2,817	+ 85	4·36	..
Dover	,, 16	586	+ 103	11	2,650	+ 330	4·75	+ 1½
Dublin	,, 15	12,037	+ 303	24	114,164	+ 1,001	48·5	+ ·5
Dundee	,, 13	2,260	+ 513	24	4,459	+ 877	12·5	..
East Ham	,, 16	2,207	+ 332	11	10,435	+ 1,152	8	+ ½
Exeter	,, 15	727	+ 55	11	3,127	— 366	4·25	..
Glasgow	,, 16	37,073	+5,224	3	43,676	+ 3,997	80·25	+ 6½
†Gloucester	Feb. 21	221	+ 12	..	..	..	15	..
Halifax	June 13	4,671	+ 559	11	18,410	+ 1,030	37	+ 1·5
Hastings	,, 15	1,740	..	..	..	..	..	..
†Huddersfield	,, 9	2,178	+ 80	10	15,496	+ 2,214	28	..
Hull	,, 16	4,838	+ 185	11	24,538	+ 443	13	..
Ilford	,, 16	1,223	+ 80	11	5,686	+ 205	6·37	..
Ilkeston	,, 13	331	+ 32	11	1,411	+ 18	3·5	..
Ipswich	,, 16	1,104	+ 29	11	4,669	— 85	10·5	..
Isle of Thanet	,, 16	1,566	+ 148	24	8,468	— 398	11	..
Kilmarnock	,, 16	322	— 4	5	721	— 41	4·12	..
Kirkcaldy	,, 13	471	+ 26	..	..	..	7·5	..
Lan'kshire Trm. Co.	,, 14	1,962	+ 573	24	20,451	+ 4,698	12·5	+ 3·9
Leeds	,, 9	14,821	+2,569	10	63,430	+ 5,521	96·5	+ 7¼
Leicester	,, 16	5,393	+ 144	24	51,301	+ 4,209	..	..
Leith	,, 9	1,068	+ 685	3?	1,927	+ 1,049	6	+ 1
Liverpool	,, 9	23,369	+1,712	23	241,066	+ 7,058	104	+ 1
‡L.C.C.	,, 2	50,443	+10,262	10	..	..	97½	+50
London United	,, 15	18,051	+3,241	24	137,050	+ 7,773	..	..
Lowestoft	,, 17	362	— 76	38	5,004	— 299	3·5	..
Manchester	,, 16	31,913	+3,029	11	149,343	+ 7,995	84	..
Newcastle	,, 16	8,120	+ 139	11	43,337	+ 1,871	25·5	..
Newport	,, 9	1,498	+ 346	10	6,318	+ 561	14·5	+ 1·5
Northampton	,, 15	1,151	— 31	11	4,838	+ 30	5·5	..
Oldham	,, 17	3,910	+ 647	12	21,386	+ 1,779	23·75	..
Pontypridd	,, 16	422	+ 9	11	1,951	— 28	3·5	..
Portsmouth	,, 16	5,224	+ 691	11	21,492	+ 139	14·5	..
†Preston	,, 6	1,174	+ 540	..	..	..	10	..
Reading	,, 14	1,501	+ 63	11	6,123	+ 31	7·5	..
Rochdale	,, 16	2,645	+ 863	11	11,831	+ 4,651	20·6	+ 1·7
Rotherham	,, 14	1,276	+ 182	11	5,404	+ 514	9·3	..
†Salford	,, 11	6,439	+1,775	10	46,811	+ 2,431	38·9	..
Sheffield	,, 17	11,604	+1,081	12	63,086	+ 4,400	35·75	+ 1½
Southampton	,, 13	2,275	+ 86	10½	10,079	+ 105	..	..
†Southend-on-Sea	,, 13	411	— 107	11	3,834	+ 194	6	..
†Stalyb'dge, Hyde, &c	Apr. 21	807	+ 100	3	2,456	..	21	..
†Stockport	June 1	884	+ 240	9	8,117	+ 2,834	15·5	+ 4
Sunderland	,, 17	3,254	+ 62	11	15,225	+ 830	10·87	..
Swindon	,, 13	553	+ 118	10½	2,158	+ 77	4·4	..
Tyneside	,, 13	1,136	+ 30	24	9,530	+ 500	8·87	..
Walthamstow	,, 16	1,651	..	11	6,846	..	10	..
Warrington	Mar. 29	677	+ 43	52	17,804	+ 1,247	6·37	+ ·25
West Ham	June 14	5,151	+1,631	11	25,119	+ 8,339	14·7	+ 8½
Wolverhampton	,, 13	2,252	..	..	..	..	10	..
Yorks. W. Riding	,, 17	2,257	+ 91	24	18,783	..	..	..
Baker St.-Waterloo	,, 16	2,933	..	14	20,336	..	3·25	..
Cen. London Rly.	,, 16	12,653	— 600	24	161,376	— 5,593	6	..
City & S. Lon. Rly.	,, 17	5,026	— 258	24	67,490	+ 84	6·25	..
Dublin-Lucan Rly.	,, 15	323	— 15	24	2,523	— 149	7	..
G. N. and City Rly.	,, 16	3,489	+ 344	24	43,028	+ 2,349	3·5	..
L'pool Overh'd Rly.	,, 17	3,219	— 150	24	33,952	— 2,466	6·65	..
Mersey Railway	,, 16	3,784	+ 289	24	41,661	+ 2,812	4·5	..
Metropolitan Rly.	,, 17	33,095	—4,698	24	391,688	—26,604	70·5	..
Met. District Rly.	,, 17	16,588	+1,177	24	192,821	+13,280	24	..
Anglo-Argentine	,, 17	28,734	+3,186	24	359,269	+38,505	43	..
§Auckland	May 26	9,789	+ 662	21	51,164	+ 2,873	18·64	..
§Brisbane	,,	11,691	+ 776	..	..	..	..	..
§Brit. Columbia Rly.	Apr.	14,603	+3,102	43	156,563	+40,397	..	..
Bu'n's A'r's E.T. Co.	May 19	2,681	+ 410	19	28,140	+ 5,684	24	..
Bu'n's A'r's-Blgr'no	June 10	7,045	+ 338	23	82,498	+ 5,604	..	..
Calcutta	,, 16	5,769	+ 32	..	..	..	..	..
§Cape Electric T. Ld.	May	14,806	..	..	..	..	..	..
§Geneva	,,	7,977	+ 195	..	..	..	..	..
Perth (W.A.)	June 15	2,895	+ 239	24	86,158	+ 1,964	24·25	+ 5

* Compared with the corresponding period of 1905. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Wednesday Afternoon.

ORDINARILY the writing of these weekly jottings is a matter of some pleasure. But it must be frankly confessed that this week's task is a very unhappy one. For this reason. Recommendation of South Wales Electrical Power Debenture stock for investment, and of the shares as a speculation, has been repeated here several times. And now the company seeks power to issue prior lien debenture stock to the extent of half a million pounds, the existing debenture stock has fallen to something like 50, and the shares are nominally about 10s. To venture advice concerning an absolute gamble which turns out badly is mortifying enough, but speculation implies possible loss. With investment, however, where counsel to buy what is honestly believed to be a sound, well secured stock, the miscarriage of every calculation—involving loss of a very different character—brings a sting of bitterness, the acuteness of which is the only excuse for mentioning the matter in this way.

Hope for the company has not entirely died. Nothing can be done until after the meeting on July 2nd, but no effort will be spared to obtain all information possible for this column.

From this subject, one passes to review markets as unsatisfactory as those of last week. Electrical railway stocks are weak, particularly those of the Central London. A dealer in the market offered to bet three to one upon the maintenance this half-year of the regular 4 per cent. dividend, but the competition of motor-omnibus is emphasised by the appearance of a new issue of Preference shares by the London General Omnibus Co., the money being required for the new mode of traction. There is, by the way, a scheme in the air for a working arrangement between several of the motor-omnibus companies. Perhaps this is one reason why the Motor-'Bus Company, whose prospectus was issued some time ago, has not yet started operations. The shares are $\frac{5}{8}$—$\frac{3}{4}$, and "Vanguards" stand at 27s., the 6 per cent. cumulative Preference being 10s. discount at 4½.

While British Westinghouse Preference at 35s. are better, British Electric Traction Ordinary have fallen to 6 and the Preference to 9⅜, being declines of £1 and 12s. 6d. respectively. The dividend is generally expected to be about 3 per cent. on the Ordinary. London United Tramways fell ¼ in sympathy. District stock at 25 is lower, and Metropolitans show a small loss at 66¾. The Stock Exchange as a whole is still weak and depressed, the Russian cloud assuming dark proportions and checking whatever appetite remained for cheap stock in any department, although a fall in the Bank Rate was anticipated. In the circumstances, and in the traction group, it is quite pleasant to record rises of $\frac{1}{16}$ in Anglo-Argentine Ordinary and Preference. Cape Electrics have fallen half a crown to 15s. Belgrano Ordinary are a shade lower, and Calcuttas are both 2s. 6d. down.

Electricity Supply shares contribute their quota to the all-round dulness. Cataloguing the changes, Brompton Ordinary are ¼ down, and the Preference ½ to 8½ and 8¼. City of London Preference lost ½ at 12½, South Metropolitans $\frac{1}{16}$ at 1¼, and Urban Ordinary ¼ at 3¼. This week the provincial list gives signs of following the example of Metropolitan shares, Oxfords at 6⅝, and Hoves at 8¼ being easier. The only advances are secured by Charing Cross, City Undertaking Preference shares, both classes advancing ⅛ to 4⅛. This Wednesday afternoon the City of London Company announces an interim dividend at the rate of 5 per cent. on the Ordinary shares.

Anglo-American Telegraph Deferred had to be sold by holders, who were closing accounts in other markets, but the price, after falling to 25¼, recovered somewhat to 26. The Preferred is a point lower at 113½. Except for these movements, the Telegraph division keeps steady. Marconi's are a little down at 22s. 6d., and amongst other lower-priced shares, Oriental Telephones shed $\frac{1}{16}$ to 1⅜. National Telephone 4 per cent. Debenture hardened ½, the only alteration in the company's securities this week.

With respect to manufacturing shares the quotable changes are few. British Aluminium Preference put on ⅛ at 2⅜, and at 4¼ the Funding certificates are better. Callender's Debenture stock has improved to 110, but Electric Construction Debenture declined a point. London Electric shares have not altered upon the appointment of a special settlement in 10,000 new Preference for next Wednesday. Manx Electric Preference shares and Debenture stock are to have their special settlement in the following week.

Bank Rate Altered.—The Bank rate was yesterday reduced to 3½ per cent.

British Electric Traction Co.—The directors recommend a dividend of 3 per cent. on the ordinary shares for the year ended March 31st, 1906. This compares with 6 per cent. in the previous year.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations June 13th.	Closing Quotations June 20th.	Business done week ended June 20th, 1906. Highest	Lowest.	Rise + or Fall —
17,700	African Direct Telegraph, 4 % Debs...	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3 — 3½	3 — 3½	..	..	..
155,600£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	88 — 88	88 — 88	..	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	23/8	31/8	67 — 69	67 — 69	67½	67	..
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5⅛ %	6 %	114 —115	113 —114	114½	113	—1
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	1/8	26½ — 26⅝	25⅞ — 26⅛	26 1/16	25½	— ⅜
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	101 —103	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	..	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..
1,932,856£	Commercial Cable Stng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	97 — 99	97⅞ — 99½	99⅛	99	+ ⅛
16,000	Cuba Telegraph	10	6⅛ %	10 %	5 %	5 %	8½ — 9	8⅜ — 9	..	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18	17 — 18	..	..	..
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜ — 3⅝	3⅜ — 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 %	8½ — 9	8½ — 9	..	..	..
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —103	100—103%	..	..	..
60,710£	Direct United States Cable	20	3⅛%	3 %	3⅛%	3⅜%	15½ — 16	15⅝ — 16	15⅝	15 11/16	..
70,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200,R.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	143 —146	143 —146	145½	143½	..
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	90 — 92	90 — 92	90⅝	90¼	..
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	107 —109	107 —109	108½	107½	..
800,000	Eastern Extension, Australiasia, and China Tele.	10	7 %	7 %	7 %	7 %	14 — 14½	14 — 14½	14⅜	14⅛	..
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105½—107½	105½—107½	107½	..	..
800,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	100 —102	..	..	+1
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
180,887	Globe Telegraph and Trust	10	£3	5⅛%	5⅛%	5⅛%	10⅞ — 11⅛	10⅞ — 11⅛	11	10⅝	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅜ — 14⅞	14⅜ — 14⅞	14 13/16	14⅜	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	39 — 41	39 — 41	41	39⅝	..
42,300	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	13 %	57 — 59	57 — 59	..	..	..
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1⅛ — 1⅜	1 — 1⅛	21/3	..	— ⅛
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	3 %	4 %	..	1 1/16 — 1 3/16	1 — 1	..	..	— ⅛
86,492	Do. do. do. 5 % Pref.	1	5 %	5 %	5 %	..	⅞ — 1	1 1/16 — 1 1/8	..	..	+ 1/16
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	110 —112	110 —112	111⅜	110½	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	108 —110	108 —110	109	108¼	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	12 — 14	12 — 14	..	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10 — 12	10 — 12	11⅜	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5½ — 5⅝	5½ — 5⅝	5⅝	5 13/16	..
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98 —100	99½	98⅜	..
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	103 —105	103½—105½	104½	..	+ ⅛
179,313	Oriental Telep. and Elec. 1 to 171,504,fully paid	1	6 %	6⅛%	6⅛%	7⅛%	1⅜ — 1½	1 1/16 — 1 1/8	27/6	..	— 1/16
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1½ — 1⅝	1½ — 1⅝	25/-	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	99 —101	99 —101	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..
11,839£	Reuter's	8	5 %	5 %	5 %	5 %	7½ — 7⅞	7½ — 7⅞	..	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	103 —106	103 —106	104½	..	..
3,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	127 —130	127 —130	..	..	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	..	7 — 7½	7 — 7½	7 1/16	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	110 —113	110 —113	..	..	..
15,609£	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9⅜ — 10⅜	9½ — 10 xd	..	..	— ⅜
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	Nil	3/4 — 7/8	3/4 — 7/8	15/-	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	5 %	14½ — 14⅝	14½ — 14⅝	14⅝	14 1/16	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	101 —103	101 —103	..	..	..
563,280	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —106	104 —107	106	..	+1
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	7/16 — 9/16	7/16 — 9/16	8/9	..	..
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %*	7 %*	6 %	5 %	6⅛ — 7	6 — 7	6⅝	6⅛	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	4⅛ — 5⅛	4⅛ — 5⅛	..	..	..
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,600 ..	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..

* Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

170,000	Anglo-Argentine Trams, 260,008 to 430,007	5	..	..	8 %	8 %	6 13/16 — 7 1/16	6⅞ — 7⅛	7 1/16	6 31/32	+ 1/16
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5 15/16 — 6 1/16	5⅞ — 6⅛	6	5 15/16	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	140 —143	140 —143	140⅛	..	..
295,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	104 —106	104 —106	106⅜	..	..
800,000	Babcock & Wilcox, 1 to 530,000	1	..	17 %	20 %	20 %	3⅜ — 4⅜	3⅞ — 4⅛	81/3	78/1½	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1¼ — 1⅜	1⅛ — 1⅜	..	..	..
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	2⅜ — 2⅝	2¼ — 2½	46/10½	..	+ ⅛
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	7 %	7 %	5⅞ — 6¼	5⅞ — 6¼	6¼	6	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5¼ — 5⅞	5¼ — 5⅞	5⅞	5 7/8	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	3¾ — 4¼	4 — 4¼	80/-	78/9	+ ½
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —104	100 —104	102⅜	..	..
300,000	British Columbia E. Rail Def. Ord. Stock ..	100	..	6 %	6 %	6 %	115 —118	115 —118	..	..	..
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	107 —110	107 —110	..	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	107 —110	107 —110	109⅛	108½	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	102 —104	103 —105	..	..	+1
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	..
183,301	British Electric Traction	10	8 %	6 %	6 %	..	6⅜ — 7⅛	5⅛ — 6⅜	6⅜	6 1/16	— ⅛
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 ⅝	9⅛ — 10⅛	9⅛ — 9⅜	9 1/16	9⅛	— ⅛
1,415,422£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	115 —118	112 —115	114	..	—3
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	93 — 95	93 — 95	..	..	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6⅛ — 7	6⅛ — 7	6 1/16	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝ — 6⅛	5⅝ — 6⅛	6	5 7/8	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	104 —107	104 —107	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1 — 1⅛	1⅛ — 2	35/-	22/6	+ ⅛
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	79 — 84	80 — 85	..	..	+1
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	2/16 — 3/16	3/16 — 4/16	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	2½%	3/8 — 1/2	3/8 — 7/16	13/9	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	1½ — 2	1½ — 2	32/6	..	..
125,000£	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	97 — 99	97 — 99	..	..	..
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	84 — 86	84 — 86	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3⅜ — 3⅝	3 1/16 — 3 3/16	70/-	..	— 1/16
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5⅜ — 5⅝	5⅜ — 5⅝	5 11/16	..	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	..	..	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	106 —108	106 —108	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	103 —106	103 —106	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	8⅜ — 9⅛	8⅜ — 8⅛	..	..	— ⅛
32,610	Do. 105,001 to 137,610	5	..	..	..	8 %	8⅜ — 8⅝	8⅛ — 8⅜	..	..	— ⅛
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	106 —108	106 —108	..	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	10⅛ — 11⅛	10⅛ — 11⅛	10⅜	..	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅞ — 6	5⅞ — 6	..	..	..
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108½—110½	109 —111	..	..	+ ½
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %§	3/8 — 7/16	3/8 — 3/4	..	..	— ⅛
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..
230,211	Do. do. 4½ % 1st Mort, Deb. Stock	100	..	4½%	4½%	4½%	97 —102	97 —102	..	..	..
1,939,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	86 — 88	84 — 87	87	86	—1½
630,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	99 —101	99 —101	100½	..	..
630,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	77 — 80	74 — 77	..	..	—3
1,480,000	City and South London Railway	Stock	3⅛%	2⅞%	2⅛%	1⅞%	40 — 42	40 — 42	..	..	..
85,000	Crompton & Co., Nos. 1 to 85,000	5	5 %	2½%	2½%	..	1⅛ — 2⅛	1⅛ — 2⅛	37/6	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 — 99	96 — 99	..	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued).*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations June 13th.	Closing Quotations June 20th.	Business done week ended June 20th, 1906. Highest	Lowest.	Rise + or Fall—
260,000	Dick, Kerr & Co., 1 to 260,000	£1	..	..	10 %	..	1⅞ — 1¾	1⅞ — 1¾	..	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	£1	..	6 %	6 %	6 %	1⅛ — 1¼	1⅛ — 1¼	..	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	104 —107	104 —107	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½%	6 %	6 %	13⅜ — 14⅜	13⅜ — 14⅜	..	..	..
59,987	Do. 6 % Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14⅜ — 15⅜	14⅜ — 15⅜	..	..	..
63,400	Do. 4 % Debs.	100	..	4 %	4 %	4 %	99½ —100½	99½ —100½	..	..	..
300,000	Do. 3½ % "A" Debs.	100	..	3½%	3½%	3½%	95 —100	95 —100	..	..	..
300,000	Do. 3½ % "B" Deb. Stock	100	..	3½%	3½%	3½%	95 —100	95 —100	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	£	Nil	Nil	2½%§	..	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..
17,139	Do. "A" shares, 01—017,139	£	Nil	Nil	2½%§	..	2⅝ — 3	2⅝ — 3	52/6	..	..
344,028£	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..
100,000£	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	£	6 %	4 %	Nil	..	⅜ — ⅝	⅜ — ⅝	10/-	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	£	7 %	7 %	7 %	..	2 — 2½	2 — 2½	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	89 — 92	88 — 91	..	..	—1
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	9¼ — 9⅜	9¼ — 9⅜	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	93 — 97	93 — 97	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	3⅞ — 4¼	3⅞ — 4¼	..	..	..
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10½ — 11¼	10½ — 11¼	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	100 —101	100 —101	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	£	20 %	15 %	15 %	15%	12 — 13	12 — 13	12	..	..
200,000	Do. do. 4½ % Pref.	£	4½%	4½%	4½%	4½%	5¼ — 5½	5¼ — 5½	5¼	..	..
41,978	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107 —109 xd	107 —109	..	..	..
108,022	Do. do. Scrip. All paid	..	..	..	..	..	57⅛ — 59½	57⅛ — 59½	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works..	10	10 %	10%	5 %	10%	17 — 18	17 — 18	17⅛	..	..
37,500	‡Liverpool Overhead Railway, Ord.	10	12½%	12½%	12½%	Nil	1⅜ — 1⅝	1⅜ — 1⅝	..	..	+ ⅛
10,000	‡ Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	4 — 6	4 — 5	..	..	— ½
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	3 %	8 — 8¼	8 — 8¼	8⅛	8⅛	..
399,930	Do. do. 60,008 to 100,000 (£6 paid)	10	..	8 %	6 %	3 %	1 — 3	4 — 5	..	..	+2½
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	8¾ — 9⅛	8¼ — 9½	..	..	— ¼
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	96 — 99	96 — 99	97½	..	..
314,016	Metropolitan Electric Trams, Defd.	£	Nil	Nil	Nil	3 %	⅛ — ¼	⅛ — ¼	2/9	..	..
500,000	Do. 5 % Cum. Pref.	£	5 %	5 %	5 %	5 %	¼ — 1	⅛ — 1	18/9	..	..
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	102 —104	102 —104	103	..	..
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	£	..	..	6 %	6 %	4¾ — 5	4¾ — 5½	..	..	..
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	4 %	7 — 8	7 — 8	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	7⅞ — 8⅞	7⅞ — 8⅞	8 7/32	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	100 —103	100 —103	102⅞	101½	..
37,350	Telegraph Construction and Maintenance	£	20 %	20 %	15 %	15 %	32 — 34	32 — 34	33½	..	..
150,000£	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	102 —104	102 —104	..	..	..
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	94 — 96	94 — 96	..	..	..
540,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3½%	100 —103	100 —103	100½	100½	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	£	8⅓%	3 %	Nil	Nil	1¼ — 1⅜	..	..	..	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	£	..	6 %	Nil	Nil	2⅜ — 3½	2⅜ — 3½	..	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	78 — 83	78 — 83	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	£	..	5 %	5½%	4 %§	5⅛ — 5⅝	5⅛ — 5⅝	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	£	8 %	10 %	10 %	10 %	8¼ — 9¼	8 — 9	..	..	— ¼
10,623	Do. do. 7 % Cum. Pref.	£	7 %	7 %	7 %	7 %	8¼ — 9¼	7⅞ — 8¼	..	..	— ¼
300,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	100 —103 xd	100 —103	..	..	..
80,000	Charing Cross and Strand Electricity Supply	£	10 %	8 %	8 %	5 %	4 — 5	4 — 5	..	..	..
80,000	Do. do. do. 4½ % Cum. Pref.	£	4½%	4½%	4½%	4½%	4⅜ — 4¾	4⅜ — 4¾	..	..	..
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	£	4½%	4½%	4½%	4½%	3⅞ — 4¼	3⅞ — 4⅜	83/9	..	+ ⅛
40,000	Do. do. 1903	£	..	4½%	4½%	4½%	3⅞ — 4¼	3⅞ — 4⅜	83/9	..	+ ⅛
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —103	100 —103 xd	..	..	— ½
44,436	Chelsea Electricity Supply, Ord.	£	4½%	5½%	6 %	6 %	5¾ — 5⅞	5¾ — 5⅞	..	..	..
175,000£	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108 —110	108 —110	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	10¼ — 11¼	10⅝ — 11¼	..	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	12⅝ — 13⅜	12 — 13	..	..	— ½
400,000£	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	125	123½	..
300,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
40,000	County of Durham Electrical Power, Ord.	£	4 %	4 %	£3 7 0	4 %	2 15/16 — 3 3/16	2 15/16 — 3 3/16	..	..	..
50,000	Do. do. do. 5 % Pref.	£	5 %	5 %	5 %	5 %	5 — 5½	5 — 5½	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	5 %	8 — 9	8 — 9	..	..	..
30,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	11¼ — 12½	11⅛ — 12½	12	..	..
400,000£	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	109 —112	109 —112	110¼	109¼	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —103	101 —104	..	..	+ ½
80,000	Edmundson's Electric Corporation, Ord. Shares	£	7 %	7 %	7 %	5 %§	3¾ — 4¼	3¾ — 4¼	80/-	..	..
80,000	Do. do. 6 % Cum. Pref.	£	6 %	6 %	6 %	6 %	4¼ — 5	4¼ — 5	..	..	..
820,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	103 —106	103 —106	104	..	..
10,000	Folkestone, 1 to 10,000	£	..	5½%	5½%	5½%	5⅝ — 5⅞	5⅝ — 5⅞	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	£	..	..	..	5 %	5 — 5½	5 — 5½	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
13,000	Hove, 1 to 13,000	£	..	8½%	8½%	9 %	8¼ — 8¾	8 — 8¼	..	..	— ¼
10,000	Do. New (£6 10s. paid)	£3	..	8½%	8½%	9 %	7⅞ — 8¼	7 — 7⅞	..	..	— ¼
37,300	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	96 — 99	98 —101	..	..	+2
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	96 — 99	98 —101	..	..	+2
21,000	Kensington and Knightsbridge Electric Ord.	£	10 %	12½%	12 %	10 %	10 — 11	10 — 11	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	£	Nil	Nil	3 %	4 %	2 — 2½	2 — 2¼	..	..	..
60,000	Do. do. do. 6 % Pref.	£	6 %	6 %	6 %	6 %	5 — 5½	5 — 5½	5 7/32	..	..
874,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	98 —101	97 —100 xd	..	..	—1
200,000	Metropolitan Electric Supply, 1 to 100,000	£	7½%	8½%	10 %	10 %	8 — 9	8 — 9	..	..	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	£	4½%	4½%	4½%	4½%	5⅝ — 5⅞	5⅝ — 5⅞	..	..	..
220,000£	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	110 —114	110 —114	..	..	..
250,000£	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	£	..	8 %	8 %	8 %	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	£	..	5%	5 %	5 %	5¾ — 6¼	5¾ — 6¼	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7½%	13 — 14	13 — 14	..	..	..
64,000	Do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	£	..	6½%	7 %	7 %	6½ — 7	6⅜ — 6¾	..	..	— ⅛
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	99 —101	99 —101	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£	14½%	14½%	14½%	12½%	10¾ — 11¼	10¾ — 11⅛	..	..	..
20,000	Do. do. 7 % Pref. 20,081 to 40,080	£	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..
150,000£	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	96 — 98	96 — 98	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£	2½%	4 %	4 %	4 %	2¼ — 2⅝	2¼ — 2⅝	..	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..
65,000	South London Electricity Supply, Ord.	£	1½%	3 %	4 %	4 %	2⅜ — 3⅝	2¾ — 3½	..	..	..
103,700	South Met. Elec. Lt. & Power (Ord.	£	Nil	Nil	Nil	2½%	⅜ — ⅝	⅜ — ⅝	..	..	..
85,368	*(Late Blackheath and Greenwich* 7 % Pref.	£	Nil	7 %	7 %	7 %	1⅝ — 1⅞	1 11/16 — 1 15/16	..	..	— 1/16
148,292	*Dist. E.L.Co.)* 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
50,000	Urban Electric Supply, Ord.	£	5 %	5 %	5 %	5 %	3½ — 3⅞	3 — 3½	..	..	— ¼
80,000	Do. do. 5 % Cum. Pref.	£	5 %	5 %	5 %	5 %	4½ — 5	4½ — 5	..	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	100 —102	100 —102	..	..	..
110,000	Westminster Electric Supply, Ord.	£	12 %	13½%	14 %	13 %	10¼ — 11¼	10¼ — 11¼	11¼	..	..
28,151	Do. do. 4½ % Cum. Pref. (Originally 5 %—Red. to 4½ % from 31st Dec., 1905.)	£	5 %	5 %	5 %	5 %	5 5/16 — 5 7/16	5 5/16 — 5 7/16	5½	5⅜	..

Shares not officially quoted :—Mackay Companies, ord., 78—79. Pref. 76½—77½.

† Unless otherwise stated all shares are fully paid. § Interim dividends.

(Bank rate of discount 4 per cent. (May 3rd. 1906).

LEGAL.

CHITTY *v.* BRITISH WESTINGHOUSE ELECTRIC, &c., CO., LTD.

(*Continued from page* 958.)

WEDNESDAY, JUNE 13TH.

UPON resumption of the case, the examination-in-chief of plaintiff was continued. He said that on November 12th, 1903, Mr. Wells said they were prepared to put his machine into the Savoy Hotel, providing an agreement was come to that day, but they would not pay him any royalty. If they did not come to an agreement, Mr. Wells said that he should order the machines to be built from designs which had been prepared in their drawing office. Up to that time witness had no idea that there were any such drawings. He refused to agree to their terms, and he was asked to sketch out his own idea of an agreement, and he did so, but it came to nothing. The machine he built for the Savoy Hotel was tested on January 29th and 30th and February 4th, 1904, and those tests were electrically successful. The four machines for the Savoy Hotel were designed by Mr. Beyer, and he had included in his designs the auxiliary poles and windings, the slots and the combination. The stamping produced represented the slotting put into the machine, and it was his system. Plaintiff proved the specification prepared for patenting his method of slotting, and said that defendants' machines supplied to the Savoy Hotel included the feature illustrated in fig. 5 of that specification. When he went to defendants' bureau about patenting his slotting idea, no one suggested that it was not novel to them. Defendants made certain alterations in their auxiliary poles, and then the combination was exactly similar to his own. He had seen Mr. MacLean's specification for ventilating plates, and the two produced were made in accordance with that specification, and also in accordance with his plate as disclosed to the defendants. They were made of thin sheet magnetic metal, and had little tongue pieces stamped out to hold the vanes. The difference between those plates and his plates was that the vanes in them were T or L-shape, whilst his vanes were of rectangular shape. He dealt with that difference in a letter to Mr. Cachemaille, and caused a letter of complaint to be written by his solicitors to the defendants on April 15th, 1904. An interim injunction was obtained in June.

Cross-examined by Mr. CRIPPS, WITNESS said he complained that defendants had taken advantage of his information with regard to ventilating plates. He told them that his vanes were held in position by little projecting pieces, punched up on that of the plate. There was nothing else of any importance that he told defendants with respect to the vanes. In the two original machines at Sir Hiram Maxim's works he did not have the punched-up pieces at all. He admitted that riveting in connection with ventilating plates and vanes was well known, and he did not suggest that the original machines would give any information to the defendants which was not common knowledge with regard to ventilating plates. In February, 1903, he sent a drawing to the defendants, showing the method of construction of ventilating plates. It showed vanes in a curved form held in position by punched-up pieces, but that method of holding the vanes was not, to his knowledge, perfectly old at the time. He was not aware of a patent of Mr. Westinghouse's brought out in 1895, showing punched-up lugs. That specification did not show punched-up lugs, but vanes. Lugs answered the purpose of vanes, but they were a different thing altogether. Witness then identified models of the ventilating plate, which he disclosed to defendants, of the form of plate according to Mr. Westinghouse's patent of 1895, and of the plate which he said defendants had used in 219 machines, and of which he complained as being a breach of the covenant. In the first model curved vanes were held in position by means of lugs, and a specification for a United States patent of 1900 of Mr. Faure, showed vanes attached to armature plates by substantially the same system of punched-up lugs.

Mr. Justice BIGHAM: Supposing you had known of the Faure patent, would you have suggested that there was any secret or novelty about your system?—Not in regard to the method of holding vanes.

Mr. CRIPPS: There was nothing in any sense new in attaching vanes to armature plates at that date by means of lugs?—I should not like to say that.

Further cross-examined, PLAINTIFF said that in his letter of May 27th, 1903, to Mr. Cachemaille, he called attention to certain variations in the method of attachment. Those variations showed lugs bent over on to the bottom flanges with T and H shaped vanes so as to keep them in place, and he said that that was the same as his system of having punched-up lugs with curved vanes held in position by them.

Mr. Justice BIGHAM: Does the advantage of your system consist merely of punched up pieces out of the plate?—Yes, for the purpose of holding the vanes.

Then it boils down to this, that what you claim as the novelty you disclosed to the defendants, was the holding of the vanes in position by punched-up pieces?—Yes, whether turned down or not.

Further cross-examined, PLAINTIFF admitted that the curvature of the vanes made them more secure, but the armature was built up under very great pressure, and if properly built the end pressure would hold the vanes.

Mr. Justice BIGHAM: Then why do you curve them?—To help ventilation.

Mr. CRIPPS: I put it to you that they could not have been held in position by your method without their being curved?—They could have been held, certainly.

So that the machine would be a practical working machine?—Certainly.

Proceeding, PLAINTIFF said he would not admit that the method of attachment seen in defendants' 219 machines was a well-known method of attachment at the time.

Mr. Justice BIGHAM: Have you ascertained that that system was known at the time, although not to you?—I think there is no doubt that it was known to some manufacturers, but I do not know that it had been used.

Then, though you knew they did not know it, it was a thing which was known?—Yes, it may have been known to some.

Have you ascertained in point of fact that it had been used?—No, I cannot say that I have.

Have you any reason to suppose that it had been used?—I have no positive knowledge.

Mr. CRIPPS: You signed a memorandum saying that it had been decided to omit the part of the invention relating to these ventilating plates, because you had ascertained they were old?—I did.

Therefore, what you were giving to us as information in May, 1903, by the diagram, was the same as the diagram it was proposed to attach to the specification?—Yes.

And at the date of the specification you were willing to abandon any claim as regarded these ventilating plates on the ground that they were known and old since 1900?—Yes.

By Mr. Justice BIGHAM: He was willing to abandon the patent for his plates, because he was satisfied that they were not novel.

Further cross-examined, PLAINTIFF said he was not aware that the method of attachment by punched-up lugs, as illustrated in the *Railway Journal* in June, 1903, and which was similar to his, had been used for a very long time. He could not say that the method of attachment used in defendants' 219 machines was a perfectly well-known method, and was used particularly in attaching flanged rails to steel sleepers. The attachment illustrated in the *Engineer* of 1897 was applied to a very different purpose, although the contrivance was similar to that of plaintiff. He did not know that the system of attachment was in common use in hundreds of ways.

Mr. Justice BIGHAM: Then am I to understand that so far as you are concerned you had invented it?—Yes.

You did not get the information from any source other than your own brain?—No.

Though apparently it had been invented by a great many other people?—So it appears. The method of attachment, plaintiff said, was old, though he did not know it was so at the time. Whether it was old or new, however, it had not been used in connection with ventilating plates, according to his belief. He was the first to suggest to defendants that it might be so used, and by making 219 machines with that suggestion they had broken their covenant.

In reply to further interrogations, PLAINTIFF said that at the time his specification was drawn up in 1903 he had no knowledge of anything in the way of his system of slots in auxiliary poles, but at the date the proposed specification was abandoned, in August, 1903, he knew that slots had been used in pole-pieces. His object was to get as little distortion as possible of the lines of force, because distortion caused sparking in the commutator. He had now ascertained that at the time he disclosed the information to defendants, the system of slots was known to some, but was not commonly known, and he believed they were used. He, however, discovered the value of the slots without any information from anybody else; it just so happened that as in the other instance, his mind and somebody else's mind invented the same thing. A specification of 1900 showed a pole-piece with slots, but they were differently arranged. He disclosed a special form of slots to defendants. The specification of 1900 showed slots, but his specification described a method of controlling the strength of the flux in any part of the pole face, which was a totally different thing.

Mr. CRIPPS: Do you say we used any special form of slotting of which you gave us information?—No.

Mr. Justice BIGHAM: Then I do not know what becomes of this "slotting" point.

PLAINTIFF: It is not the right way to put the question at all.

Sir ED. CARSON: There is a great deal in that.

Mr. Justice BIGHAM: If the defendants have not used a form of slotting that you disclosed to them, I do not know what they had done wrong?—There is nothing in that form of slotting; it is the object aimed at. The slot is only the means to the end.

Mr. Justice BIGHAM: I should like you to answer what you consider would be a fair question?—My specification describes a means of regulating the strength of the magnetic flux in such a way that it is stronger at the sides and weaker in the middle, and the defendants had used that method.

Do you now complain that you divulged to the defendants any specially shaped slots?—No, I do not attach any importance to the shape of the slot.

Cross-examination continued: They were agreed that the object of slotting the pole-pieces was to prevent distorting of the cross-current and so to prevent sparking. The object of the auxiliary pole-piece was to get reversal of the pole-piece quickly. In order to get no distortion at full load you must get the flux at full load. What he called the combination of the auxiliary pole and slot was a combination to prevent sparking in the commutator. He did not claim a special form of slot. The slot was simply a means to an end. He was claiming all forms of slots, whether they brought about the symmetrical or unsymmetrical distribution of flux. If the defendants used any slots for any purpose, his assertion was that they broke their bargain. He contended that his discovery to the defendants precluded them from using slots for the purpose of preventing distortion.

Mr. CRIPPS: At this date the use of slots to prevent distortion

was well known in the use of dynamos?—It was not known to me.

Where was your electrical education?—My education was my knowledge of electrical matters gained from practical experienec.

Were you trained in any school or large firm?—No, I have made a study of it from infancy or childhood.

When did you become a civil engineer or a member of the Institution?—I am a mechanical engineer and an electrical engineer.

Are you a member of the Institution of Civil Engineers?—No; I do not aspire to be one.

You have not been trained in any particular way or in any particular firm?—Yes; I have been trained in engineers' works.

Further cross-examined, the Witness said he was with a firm of mechanical engineers at Halstead for about 18 months or two years. He had never been with any electrical firm. He was aware in 1903 of the use of auxiliary poles in connection with dynamos. He did not claim any novelty in regard to auxiliary poles. He claimed novelty in connection with auxiliary poles and slots. At page 392 of Prof. Silvanus Thompson's work there was a portion of a dynamo showing the combination of slotted pole-pieces and auxiliary pole-pieces, but that was distributed winding.

I put it to you that that shows a design of combination of slotted and auxiliary pole-pieces to prevent distortion of the current, and thereby prevent sparking of the commutator?—I deny that.

At the time you gave this information to the defendants you were aware of Prof. Thompson's book?—Yes; certainly.

His Lordship: You had read it?—Not that edition, my lord.

Which edition had you read?—I could not give you the date of the edition, but it was in an earlier edition than that.

Mr. Cripps: The slots and auxiliary pole-pieces had for their object the prevention of distortion and sparking at the commutator?—I can only answer that by saying it is not the object of the slots therein. The slots in that case are to accommodate the copper conductors or series windings. Distortion is a secondary result.

Cross-examination continued: In the first instance, his machine was built without auxiliary poles which it required to make it satisfactory. That was the machine made under the agreement of November, 1902. The reason it was not made with auxiliary poles was that the defendants wanted to handicap him by compelling him to execute auxiliary poles. MacLean, the head of the drawing department, took the drawing from the draughtsman, who was preparing them from Witness's instructions, and sent them to the manager of works, Mr. Loud. Under the agreement, nobody had any right to dictate to him how he was to construct his machine. Defendants said that his auxiliary poles were additions to his original design, but he said they were not. His original drawing had no auxiliary poles in it. The reason was because in July, when the design was advanced to that stage before he had time to go on and to do what he wanted, the drawings were taken out of his hands and put in the hands of another man. It was not true that Mr. Miles-Walker suggested to him that the machine would not work without auxiliary poles. He had always intended to have auxiliary poles. His machines were completed without auxiliary poles, but they could be added afterwards. The auxiliary poles could have been made in a few days. In the machine as originally constructed there was room for auxiliary poles. He instructed his draughtsman to make the additions before the drawings were finished.

His Lordship: When was it that you first gave any instructions to the draughtsman to make any drawings with these auxiliary poles?—Either early in December or towards the end of November.

Mr. Cripps: That was long after you said your machine was ready for testing?—It was only the next month.

Cross-examination continued: He gave the instructions to the draughtsman personally. He gave no instructions for the preparing of the drawings until about the time he wrote that the machines were practically completed. The first drawing prepared under his instructions showing auxiliary poles was on December 10th, 1903. It was not till after failure of his machine that he gave instructions to his draughtsman to prepare auxiliary poles. Defendants did not tell him that it would be necessary to have auxiliary poles to make the machine work. As a matter of fact, there were auxiliary poles in his original machine built at Sir Hiram Maxim's. In the turbo-generator made under his direction for the Savoy Hotel, the combination of the auxiliary poles and windings with his arrangement of slots was used. It was commenced in May, 1903. The drawing of the machine was designed for an unsymmetrical distribution of electric flux. He was at that time of opinion that the slots would do away to some extent with the necessity for auxiliary poles. The distortion would be less with slots and commutation would be better; but whether the addition of auxiliary poles would be necessary would depend upon the amount of output given by the machine. If the output exceeded what he expected, it would be necessary to use auxiliary poles. It had been shown that the defendants had only used slots after they had been introduced by him.

The Witness was then re-examined by Sir Edw. Carson, and the hearing was again adjourned.

Thursday, June 14th.

The hearing of the case was continued on Thursday, when the re-examination of Plaintiff was concluded. He said that during all the correspondence there was no allegation that before his disclosures defendants knew of either ventilating plates, or slots and auxiliary poles as designed by him.

Mr. Arthur Meikle, 3, Delamere Terrace, Paddington, assistant electrician in the employ of plaintiff, said he was present at the preliminary tests of the two machines which were constructed at Sir Hiram Maxim's works, and which embodied Mr. Chitty's system of ventilation and auxiliary poles, and they were electrically satisfactory. He was in attendance at defendants' works at Trafford Park, Manchester, from November, 1902, till 1904, and until within a few weeks before leaving the works he was allowed free access to every department of the works, but then he was ordered by the general manager of works to restrict his movements to a radius of 10 ft. from Mr. Chitty's machine. He concluded that defendants wanted to conceal what they were doing with the four machines for the Savoy Hotel then being constructed. He knew that they were using certain of plaintiff's inventions in those machines, and he told an employé named Sowerby so. Sowerby admitted that they were. About the same time he saw Mr. Chitty led out of the premises. When he was told to restrict his movements, Mr. Loud, the general manager of works, observed that they would be glad to have a man like him in their employ, though they did not want to take him away from Mr. Chitty. There were no machines being built with slotted pole-pieces when he first went to defendants' works, but he saw machines being so made some three or four months before he left.

Mr. Wynne, now chief electrical engineer at the Earl's Court Exhibition and formerly in defendants' drawing office at Manchester, said that in January, 1903, plaintiff instructed him to prepare drawings for a ventilating plate. Defendants were then using plates of cast metal in one section, but in the May following he saw on the table in defendants' drawing office a ventilating plate of stamped metal with punched projections. He communicated this to Mr. Chitty.

Cross-examined, Witness admitted that he had no reason to suppose that any unauthorised person was prying into his drawings during his absence.

Mr. Freedk. Nicholson, electrical engineer, and member of the Institution of Electrical Engineers, said he had notes of three tests of plaintiff's dynamo machine, and, comparing it with the ordinary commercial machine of the day, it was about 4½ times as good as the other. This was due to the ventilation, combined with the auxiliary poles, and also the divided pole-pieces. He could not see that there was any fundamental difference between plaintiff's ventilating plate and that alleged to have been used by defendants. The vanes in the one case were curved and in the other were straight. He had seen copies of the tests of plaintiff's machine at defendants' works, and he should say they were exceedingly good. He had seen the machines supplied to the Savoy Hotel, and they were provided with auxiliary poles and pole-pieces with little slots, but he could not say whether they were provided with ventilating plates with vanes fixed by punched-up pieces.

Cross-examined, Witness maintained that a six hours' test justified him in saying that the Chitty machine was 4½ times as good as others, although he admitted that defects in machines developed sometimes after running four or five days. They developed at all times. There was nothing new in punching-up pieces for the purpose of attachment. It was used in a variety of trades.

Mr. Justice Bigham: Plaintiff's point is that it had not occurred to anybody to apply the device to ventilating plates.

Mr. Zachary Harris Kingdon, Associate Member of the Institution of Civil Engineers, said he had been connected with the electrical industry since 1881, when he entered the firm of Siemens Bros., of London, where he was in charge of their installation of electrical power and works. He was now in the service of the Admiralty as an electrical engineer. On February 2nd he witnessed tests of the Chitty machines. They gave an abnormal output for a machine of that size and weight, attaining the maximum of 90 kw. The commutation was absolutely sparkless and satisfactory. The machines sustained the severe test of having a heavy load thrown off and on, and of their getting a large current with very low voltage. He had never seen such results obtained from that kind of machine and weight. They were well within the usual limits of rise of temperature allowed. He witnessed further tests on March 2nd this year, and they were equally satisfactory. He judged that it was correct to say that the weight of the machines was 1,750 lb. each, and comparing them, in respect of both weight, speed and output with machines by various well-known makers, he should say that the Chitty machine gave from 2½ to 3½ times the output of an ordinary standard machine by good makers. Assuming that the Chitty machine reached 75 kw. at 1,050 r.p.m., he should judge from the tests that the machine could maintain that. Plaintiff's ventilating plate had the advantage over defendants' old style, because it was made of a magnetic material, whereas defendants' plate was made of cast-iron material, which was unsuitable for dynamo construction; and then it was also an advantage to have the ventilating plate as thin as possible.

Cross-examined, Witness admitted that so far as the armature itself was concerned, they could have exactly as good ventilation in every respect with cast-iron plates as with steel plates. The Hiram Maxim machines were about 2½ times less in weight than the ordinary dynamo.

Mr. Cripps: Yes, and we say it is not strong enough to be useful for commercial purposes.

Re-examined, Witness said that weight was of very great importance for commercial purposes, and on account of its reduced size and weight, he thought there would be an opening for the Chitty dynamo for Admiralty purposes.

Mr. Stanley Bright, M.I.E.E., of London, said that on February 17th, he tested Chitty's two dynamo machines. They ran at various outputs up to 75 kw. with 1,060 r.p.m. The commutation was very good at all loads. The selling value of a dynamo was based mainly upon its output, and about 3½ to 1 was the comparison between the output of this machine and an ordinary

machine. There was nothing in the Chitty machines which made them commercially valueless. They were, as far as he could judge, capable of commercial use.

Cross-examined, Witness admitted that his test lasted only 20 minutes.

Mr. Wm. Armistead, a manufacturer of dynamos, said he was present at the tests of plaintiff's machines on May 31st this year. They were tested for six hours with a load of 65 kw., and the commutation was excellent. On the following day they were run half an hour with a load of 100 kw., and they went through it perfectly. He made and broke the circuit at full load several times without any trace of sparking. Since then he had put the load up to 120 kw. and had made and broken the circuit without the least sign of sparking, and without any movement of the brushes. Speaking from experience, he should say that it would require a machine 2½ to 3 times the weight of the Chitty machine to produce the same output. Two years ago no notice was drawn to machines with auxiliary poles, but now there were many advertisements drawing attention to them.

Mr. Henry Sayer, examined, said he was a member of the Institution of Electrical Engineers, and had been engaged in practice as an electrical engineer since 1881. He saw the plaintiff's dynamos in January last. He made tests with these machines, and compared with other machines they gave a very much larger output for their size. He thought they were machines producing about 20 kw., but the largest output he saw was 75 kw., and the temperature rise was very small. That was due to the ventilation.

Cross-examined: He considered that the divided pole-piece was very important in the matter of ventilation. The most novel features of the machine were its excellent ventilation and its freedom from sparking under very heavy loads.

At this stage the Court adjourned.

Friday, June 15th.

Mr. Matthew Atkinson Adam, B.Sc., A.M.I.C.E. and E.E., of the firms of Dugald Clerk & Adam, and Marks & Clerk, consulting engineers, of 18, Southampton Buildings, Chancery Lane, said he had examined the stampings of the ventilating plates of the machines supplied by defendants to the Savoy Hotel, and also the plaintiff's provisional specification of 1903 showing slots. The specification described improved means of distribution of magnetic flux. The inventor told them that a varied distribution in the pole gap might be produced either by varying areas of the sections or by varying their relative lengths, or by both; and in the Savoy Hotel machines the variation was produced by the different width of the columns, and the different areas underneath those columns.

Cross-examined: Witness said he did not know exactly what was known with regard to slots for the prevention of distortion, in 1902. He had made no experiments, but he should be glad to have it demonstrated if he were wrong in the opinion that the object of the slots in the Savoy Hotel machines was to produce a uniform distribution of flux on the pole. He cound not understand the slots producing uniform flux at no load, but, if they did produce uniform distribution of flux over the pole at no and high load, he agreed that that was not found in plaintiff's figures. There was a similarity of construction, whether the flux was the same or not. They did not get a uniform distribution of flux over the pole at no load in plaintiff's figures, but he did not think it was necessarily excluded by his language. The control of the flux might take place by means of the reluctances actually varying, although the flux might be uniform always.

Re-examined: Witness said he did not believe that either the Savoy Hotel machines or plaintiff's drawings would give a uniform distribution of flux.

Mr. Cripps, in opening the case for the defence, said that a serious allegation had been made against defendants. It was suggested that, having got information from plaintiff under conditions of secrecy, they had utilised it for their own purpose in their own business. Their answer was an absolute denial that they had obtained the information, or that they had used it. The issue between them came under three heads—ventilating vanes, slots and auxiliary poles. There was one other matter which his Lordship might have to determine, and that was the effect of the two agreements. Plaintiff alleged that they took information from them with regard to the method of attachment of the ventilating plates to the armature plate, and the only question was as to whether a certain form of attachment was first told them by plaintiff, and whether they used it for the purpose of their own business. They never denied that the two original Sir Hiram Maxim machines worked well. Those two machines included three features so far as ventilation was concerned, and with none of them had defendants anything to do. It was not alleged that they had taken any information from plaintiff with regard to the relationship of weight and output, or with regard to the attachment by riveting. They had not made use of any of the special features of the two original machines, but he should deny that they were special features. All the features were perfectly well known. The ventilating vane was attached by riveting in the machines given to defendants in October, 1902, but at a later date, in February, 1903, a drawing was sent to them showing rectangular vanes of a curved form attached by lugs punched out of the armature plate. That method of attachment gave no new information at all, and plaintiff himself admitted that in 1900 a similar method of attaching vanes by means of punched-up lugs had already been disclosed to the public. In America the defendants had been pioneers in all these electrical matters, and they came over to this country with all this knowledge. Before plaintiff's sketch came to his knowledge, Mr. MacLean had been struck by the method of attachment of rails to steel sleepers, which he thought would have been an improvement on the method of attachment used by them. There was nothing new in the punched-up lugs. Defendants had perfect knowledge of it, and Mr. MacLean and others of the company were inquiring as to a form of attachment with a flange. As a matter of fact, it was not found as satisfactory as was expected, and defendants had gone back to having merely punched-up lugs, which themselves acted as vanes. Defendants had never used curved vanes; they had always used radial vanes. When curved vanes were used they had to be held in place by means of punched-up lugs, and, therefore, they could not use that form of attachment with radial ventilating vanes. Defendants did not believe in the curvature of the vanes; they believed the radial vanes were better. When it came to the question of taking out a patent, plaintiff was shown that they were not new, and he himself withdrew the idea of making any application. He had himself stated that what he thought was new, was not, in fact, new at all. What was there to prevent defendants from using a well-known and simple form of attachment? The correspondence simply showed the extreme care they took to make certain they were not infringing any of plaintiff's rights. Dealing with the question of the auxiliary poles, Mr. Cripps said that plaintiff in regard to them made no claim *per se*; his claim was in respect of the combination of an auxiliary pole with slots in the ordinary pole. It was common ground that the object of the slots was to prevent distortion of the field, and thereby prevent sparking on the commutator, but their use was absolutely common long before Mr. Chitty became known to defendants in 1902. Mr. Miles-Walker, one of their engineers, would tell the jury that the Westinghouse Co. had made hundreds of dynamos before they heard of Mr. Chitty, in which they had this slotting in the pole in order to prevent distortion of the lines of electrical force; and, if anything turned on the actual arrangement of the slots, they would be told that in the Savoy Hotel machines they did not use the slots as specifically denoted by Mr. Chitty, because defendants' produced a uniform distribution of flux on the pole when there was no load, Mr. Meyer designing it with that intention. Then, again, the combination of slots and auxiliary poles was suggested to plaintiff by Mr. Miles-Walker, when it was found that the slots alone in the machines made by defendants for Mr. Chitty, were not sufficient to prevent sparking. Moreover, Prof. Silvanus Thompson would tell them that in substance they got the combination for which Mr. Chitty claimed in his book. Concluding, the learned counsel argued that there was nothing to prevent defendants from using knowledge known to them long before they knew Mr. Chitty, and they submitted that they did know of all these matters long before they knew Mr. Chitty at all. The agreement between plaintiffs and defendants, he submitted, only referred to information not within defendants' knowledge, and there was not a shadow of ground for the suggestion that Mr. Chitty either gave them any information under the three heads he had named, or that they had used any information derived from him for the purpose of their business in the construction of the dynamos.

Mr. M. O. MacLean, examined, said he was a mechanical engineer, now in the employ of Bruce Peebles & Co., of Edinburgh, but formerly in the employ of the defendant company in the United States, and afterwards with the British Co. in England. Whilst in the employ of the American Co., he gave considerable attention to ventilating plates in armatures. The form of ventilating plates used by the company in the States was cast-metal plates. One form very largely used, had vanes made of rectangular section, soldered or riveted on. He arrived in England and entered the service of the British Co. in 1902, and he then continued his researches in connection with ventilating plates. His official position was that of draughtsman to the British Co., but he had also the responsibility of the mechanical designs of the machines. During the winter of 1902 a scheme occurred to him which was simply a copy of the construction used on light railways where a thin piece of metal with a stamped projection held the tram-lines in place. He took the matter up with the head of the purchase department, Mr. Crumpton, so that the latter could obtain for him the form of stamp required, and eventually he got them. He made some rough sketches, which he showed to Mr. Crumpton. A specification was afterwards drawn out. He had no recollection of seeing Mr. Chitty's drawings of February, 1903, showing the lugs striking up. As the company's draughtsman, Mr. Chitty's drawings would pass through his hands in a formal way. He did not take the method of attachment shown in his drawings from Mr. Chitty's design. He examined Mr. Chitty's design of 1904 after the dispute had arisen. In 1902 the system of attachment by punched-up lugs was known to him, but he had never seen a system of attachment like Mr. Chitty's. He did not know whether it was common practice in America, but it was common practice, he understood, on the Continent of Europe. He saw the Hiram Maxim machines plaintiff had sent to the works. Mr. Chitty made no communication to him regarding ventilating plates. Defendants, he knew now, had not proceeded with an application for a patent on his specification. There was no truth in the suggestion that Mr. Chitty's drawings were taken away from him before he could put in the auxiliary poles. Chitty's original design did not provide for auxiliary poles.

Cross-examined by Sir Edward Carson: The use of ventilating plates in the armature was certainly an important matter. He and others had been interested for a long time in getting the best and cheapest form of ventilating plate. Mr. Letall, a member of the Westinghouse patent bureau staff, had suggested to him that he might patent his invention. The patent bureau were in constant communication with the company.

Re-examined: If his invention had been patented it would have belonged to the company.

His Lordship: In your opinion would this specification, which was drawn up by Letall, have ever come into existence if Mr. Chitty had not been on the premises?—It certainly would.

I am drawing attention to the specification Letall drew out. You know all the circumstances of the case in that particular connection, and I want to know from you your opinion whether that specification would have ever come into existence if it had not been that plaintiff came on to the premises with information as to ventilation?—It would. Mr. Chitty gave no information as to the specification.

Mr. W. D. Crumpton, examined, said he was purchasing agent for the defendant company at their works at Manchester. He remembered the last witness asking him to procure materials for the ventilating plates. The first written communication was dated April 24th, and the first verbal communication was, he thought, at Christmas, 1902.

Mr. M. B. Mountain, a member of the Institution of Electrical Engineers and managing director of Mountain & Gibson, examined, said in March, 1902, he joined the staff of the defendant company, and he left in October, 1904. He was in the works at Trafford Park. He remembered a discussion taking place between himself and Mr. MacLean with regard to H and T sections in December, 1902. Mr. MacLean told him he had in his mind some improvements in ventilating plates. They had great difficulty in getting anything like the sections they wanted.

Cross-examined: The only thing Mr. MacLean asked him to get was three sections of steel. None were produced until after April.

At this stage the Court rose.

(To be continued.)

F. A. Glover & Co., Ltd. *v.* the Delta Metal Co., Ltd.

Mr. Edward Pollock, the Official Referee, on Friday last, after hearing a great deal of detailed evidence in this case, reserved judgment. The facts of the case have been fully reported in a previous issue.

Dudley Corporation *v.* Dudley, Stourbridge and District Electric Traction Co., Ltd.

On Tuesday Mr. Justice Swinfen Eady gave judgment in this case. His Lordship said that the proper basis of value was that put forward by the Corporation upon which the arbitrator awarded £16,548, and he ordered the company to pay costs.

UNIQUE BOILER-HOUSE PLANT AT MESSRS. VICKERS, SONS & MAXIM'S NAVAL CONSTRUCTION WORKS, BARROW-IN-FURNESS.

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In 1897 the company purchased the works of the Naval Construction and Armaments Co., Ltd., at Barrow-in-Furness, comprising a freehold shipbuilding yard and engineering works equipped with modern plant for the construction of all types of vessels, naval and mercantile. Since then it has more than doubled the capacity of the works, and, as in the other establishments, has adopted electricity as the motive power; the following is a brief description of some of the plant installed in the boiler house of the new electric generating station.

The overhead storage bunkers and complete coal and ash handling plant, including the mechanical stokers, were all manufactured and erected by Messrs. Ed. Bennis & Co., Ltd., Little Hulton, Bolton, and 28, Victoria Street, S.W.

The boilers are ten in number, of the Lancashire type, 8 ft. in diameter by 30 ft. long, each having two furnaces 3 ft. 2 in. in diameter, fitted with "Bennis" patent machine stokers and compressed-air furnaces, in which it is possible to burn the low grade slacks used by manufacturers in the district. As evidence that it is well worth while to burn this low grade fuel, it should be mentioned that a maximum duty is obtained from the boilers, the evaporation being equivalent to 10 lb. of water per sq. ft. of heating surface per hour; and the boilers having a good natural draught, combustion is carried on at the rate of from 40 lb. to 60 lb. of fuel per sq. ft. of grate area. One of the main advantages claimed for the compressed-air furnace is that the benefit of natural draught is obtained together with a pressure under the furnace grate; the draught over the furnace is $-\frac{1}{2}$ in. water gauge, and under the grates the air is issuing into the fire at $+\frac{3}{4}$ in. water gauge, equal to a draught of $-1\frac{1}{4}$ in. water gauge. All the air for combustion depends upon that forced up the blower by the steam jet.

An automatic damper is fixed on the boilers which controls the functions of the steam-raising portion of the boiler house plant. By means of this damper steam can be kept at constant pressure, as the whole plant is automatically thrown in or out of gear within the variation of $\frac{1}{4}$ lb. steam pressure. The device consists of a small $\frac{1}{2}$ in. diameter gun-metal equilibrium valve, fixed in the main steam pipe, which is provided with two small connections, one being a small exhaust to the atmosphere and the other a live steam connection to an hydraulic valve, the latter working the various portions of the controlling apparatus. The hydraulic valve may be described as a cast-iron base, in which is a well about 8 in. in diameter and 1 in. in depth. Immediately over the well is fixed and held in position by a cast-iron column an india-rubber diaphragm $\frac{3}{4}$ in. in thickness. On the top of the india-rubber diaphragm is an ordinary cast-iron mushroom valve, on which is cast a projection for engaging with a bell-crank lever. The bottom member of the lever is about 30 in. long, and is fitted with a counter-poise or balance weight, the weight being always taken on the projection on the mushroom valve. The point of contact is about 5 in. from the fulcrum.

The well under the india-rubber diaphragm is in the commencement filled with water, and the diaphragm forming a stout joint it avoids any possibility of leakage.

The vertical member of the bell crank is coupled through an adjustable connecting rod to a lever fixed on the main swivel damper at the exit of the economiser, just before the waste gases pass to the chimney. Signal wire connections are also taken from the vertical member and laid over a series of pulleys to operate a butterfly valve that is arranged for controlling the steam to the furnace jets. A similar signal wire communication is made to a sliding strap-fork tackle, the pulley of the electric motor being wide enough to allow of the use of a pair of fast and loose driving pulleys on the line shaft.

In the first place the equilibrium valve is adjusted to the desired boiler pressure. Whenever this pressure is reached the valve is raised off its seat, and a small quantity of live steam is allowed to pass down a $\frac{1}{2}$-in. steam pipe to the hydraulic valve, where, through the medium of the water, the diaphragm is gently dilated; it raises the mushroom valve, the projection of which is in contact with the bell crank, and thus the bell crank slowly moves over, eventually shutting the exit damper from the economiser, cutting off the supply of steam from the furnace jets, and simultaneously pulling the belt on to the loose pulley. By this means the whole plant is put out of operation until the pressure has been lowered, say, $\frac{1}{4}$ lb., when the reverse operation takes place.

The chief point in this automatic control is economy in working, as it operates quite independently of the human element, which is a very important factor in the case of careless firemen who neglect to keep the steam at its normal working pressure, and, even when the boilers blow off, often forget to close the dampers, thereby wasting fuel. The exit damper of the economiser is closed, so that the heat is backed up in the damper flues and economiser. If the slide flue dampers next the boilers were closed, the chimney having a temperature of between 300° and 400° F., the draught due to this would cause cold air to find its way through any and every possible source of leakage into both the main flue and the economiser, in a short time reducing the temperature of the latter.

We are informed that this device in itself has in many cases been responsible for a saving of 5 per cent. in fuel, and it enables a maximum amount of plant to be looked after by a minimum of labour.

Returning to the main lines of the installation, the fuel is fed into the mechanical stoker hoppers from a large overhead coal storage bunker, substantially built of mild steel plates carried on a strong steel superstructure. The shoots from the bunkers project into the mechanical stoker hoppers, and as the fuel is used, it gravitates down from the overhead coal store into the hoppers, replacing that which has been consumed. The capacity of this bunker is 35 tons per boiler.

Parallel with the length of the boiler house runs a railway on which the trucks containing the fuel are brought to the boiler house. The contents of the 10-ton hopper coal trucks are discharged into a dumping bin built on one end of the boiler house and immediately under the rails. From the bin the coal is elevated through a height of about 50 ft. by means of an elevator which delivers it through a shoot upon one end of the bunker distributing conveyor. This elevator is of the "Bennis" improved type, and is capable of handling fuel at a rate of from 20 to 30 tons per hour. It is substantially formed of two trunks, each built up out of two 10 in. × 3 in. channels plated together to form a box square. The trunks are strongly braced together, rendering the elevator self-contained. A rotary feed and agitator is fixed between the bottom of the dumping bin and the boot, for the purpose of ensuring a constant feed to the elevator buckets, and to prevent the full weight of the fuel in the dumping bin from coming upon the elevator buckets with the consequent risk of jamming.

The distributing conveyor is of the standard "Bennis" patent U-link type, and conveys the fuel, delivering it through a series of openings, to any part of the bunker where it may be required. Cut-off slides with operating gear are fitted to the conveyor openings, easy access to the gear being rendered possible by means of a gangway secured to the side of the bunker.

For handling the ashes a similar conveyor to that used for the coal is fixed in a culvert running parallel with a trench underneath the boiler house floor plates. Opposite each of the boilers is a cast-iron shoot, through which the clinkers are discharged upon the chain conveyor. The ash conveyor delivers its contents to a conveyor similar to that used for the coal, which raises them through a height of 16 ft. Delivery is through a shoot into a cast-iron storage tank carried on a steel structure, the bottom of the tank being arranged at such a height that the contents can be discharged into carts through a series of radial cut-off valves.

This arrangement is economical both in labour and the floor space.

The whole of the plant is driven by three electric motors, the power required for the chain conveyor and elevator being 4 B.H.P., for the coal conveyor 4 B.H.P., and for the mechanical stokers and main coal elevator 10 B.H.P.

A TELEPHONE RELAY.*

By JOHN TROWBRIDGE.

With the view of accomplishing two results, I have constructed the following form of telephonic relay. The results to be attained are as follows:—First, the prevention of the reaction of the magnetic parts on the microphone so as to obviate the excessive roaring or "growling"; secondly, to provide means for a separate adjustment of the magnetic moving parts and the transmitter. This separate adjustment is evidently highly desirable; for the part moving in the magnetic field may be in a suitable position for the greatest sensitiveness, while the microphonic contact has not a suitable contact pressure; and any disturbance of adjustment of one of these parts of the apparatus disturbs the other. In accomplishing these results, the fact came out with great clearness that the separation of the microphonic contact by means of an air chamber from the magnetically moving parts, a separation claimed by many inventors, is inoperative unless there is a better sound-conducting medium between the microphonic contact and the vibrating part in the magnetic field than the layer of air. In fact, the layer of separating air is incapable of transmitting the feeble vibrations of a telephone diaphragm sufficiently for relaying; while a suitable solid sound-transmitting support to the microphone in contact with the edges of a diaphragm actuated by the movements in the magnetic field, transmits such vibrations very efficiently. This is an exemplification of the fact that a person partially deaf, can hear if the vibrations are conveyed to the ear by contact with the supports of the ear.

Considering thus the principles involved in the construction of a practicable telephonic relay, I have invented the relay described below; a relay in which the barrier of undesirable "growling or roaring" is obviated; and a relay which permits of the desirable separate adjustment of magnetic parts and microphonic parts.

The relay consists of a small coil with a laminated iron core which is balanced by two small diaphragms in a balanced magnetic field: the telephonic currents to be repeated or relayed enter the little coil and disturb the magnetic balance in the magnetic field.

In fig. 1, N S represent the poles of the magnetic field, C the moving coil actuated by the telephonic currents to be relayed, A and B the supporting diaphragms, D E sound-communicating support of the microphonic contacts or transmitter. This can be a heavy disk; in some experiments I have used a brass disk ½ in. thick, and have relayed loud and articulate speech. The main features of this relay are these: The magnetic field acts both in the direction toward B as well as toward A.

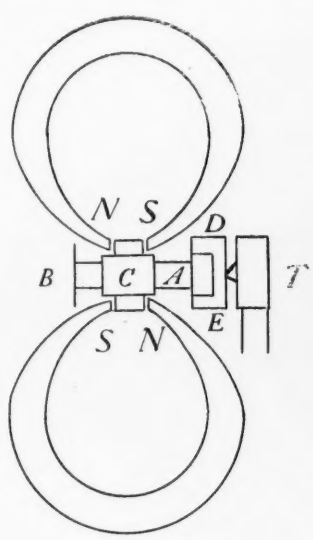

Fig. 1.

The second important principle is the freedom of the central portion of the diaphragm A from the pressure of the transmitter T. The third point is the transmission of the vibrations of this diaphragm A by means of the sound-transmitting support of the transmitter to the transmitter T. As I have already said, the air enclosed in the chamber D E plays a very small part in the transmission of the vibrations of the diaphragm A. A proof of this important fact is as follows:—

Fig. 2 represents a front view of the support D E of the transmitter, which in this case consisted merely of a metallic bar. Fig. 3 is a side view of this case. Here the air space between the transmitter and the diaphragm A is not enclosed, being open on both sides of the bar, which is connected at its edges with the diaphragm A. The transmission of speech in this case is loud, while if the connection at D and E with the diaphragm is removed and the bar upon which the transmitter rests is in the same position parallel to the diaphragm A, a very feeble sound is transmitted through the intervening air.

One can, therefore, adjust the transmitter without bringing a pressure upon the most sensitive portion of the diaphragm A, its

Fig. 2.

Fig. 3.

centre, and without disturbing the adjustment of the moving coil C. The relay is very sensitive; it is loud, and the articulation good. Moreover it is free from the objectionable growling or enhancing effect of the crepitation of the microphonic contacts on the vibrations of the magnetic portion of the relay.

The engineering problems connected with loading telephone lines are most interesting, and when completely solved may obviate the use of relays, and telephonic engineering may go through a phase analogous to that of the Morse telegraph, in which, as I have said, the telegraphic relay is subordinate in importance to good conducting lines. Nevertheless we have not reached this point yet, and the cost of a relay is practically nothing in comparison with the enormous expense of a loaded line. The relay, described in this article, seems to me to be an important solution of the problem of the telephonic relay.

* Abstract from the *American Journal of Science*, May, 1906.

THE MURRAY PRINTING TELEGRAPH.

The accompanying photograph shows the Murray automatic page-printing telegraph as installed in the Head Telegraph Office at St. Petersburg, the inventor himself appearing seated at the table.

The Murray Printing Telegraph at St. Petersburg.

The system is working between St. Petersburg and Moscow, as our readers will remember from the descriptive account that appeared in our May 4th issue, page 739.

Gravesend Electric Lighting.—The T.C. has reduced the price of energy on the flat rate by ½d. per unit.

PARLIAMENTARY.

L.C.C. Electric Supply Bill.

(*Continued from page* 959.)

WEDNESDAY, JUNE 13TH.

SIR ALEXANDER KENNEDY was called, and criticised certain of the tables put in by Mr. Hammond. Witness said that Mr. Hammond had taken the actual cost to the companies at a figure of £35 per KW., whereas the actual cost during the last four years had been just over £21. For some years to come the actual cost would only be something about £10, because land and buildings were provided, and the cost of acquiring them had swollen the cost per KW. Witness disagreed with many other tables which had been put in.

Mr. J. SOMERVILLE HIGHFIELD, chief engineer of the Metropolitan Electric Supply Co., was then called, and said that, in his opinion, the frequency of 25 cycles, adopted by the L.C.C., was quite unsuitable for any general supply. It could be transformed, but by rotary machinery only, and while it could be used for motors in large works, he understood that that was a class of business which the L.C.C. were not proposing to undertake. The only reason why the L.C.C. should have adopted that frequency, so far as he could see, was that they had got it at their Greenwich station, and that was quite an inadequate reason for adopting it for the whole of London. In distributing alternating current, the current which was distributed at 50 cycles could be much more cheaply distributed by static transformers than through rotary machinery. The proposed L.C.C. supply would be available only in those places where there were rotary transformers. He did not think that the present was the right time for stereotyping a great scheme for the future of London. In the course of further evidence, Mr. Highfield referred to a direct current supply system used in Switzerland. During the last few years it had been very much developed, and a scheme had just been started to supply over 110 miles at a pressure of 58,000 volts. He had very carefully considered that system, because with it not only was the cost of cable reduced, but the plant could be run parallel with the greatest ease. Taking 32,000 KW. as the unit of power required to be transmitted at a pressure of 6,000 volts, the cost of the cables completely laid was practically £22,000 per mile, whereas with this system the cables could be laid for £5,500 per mile. If that system were adopted for London, instead of having stations at Greenwich and Battersea, they might be a long way out of London. Witness produced sections of cables built for working at 120,000 volts and other pressures.

Mr. C. PRATT SPARKS, engineer to the County of London Electric Supply Co., Ltd., was also called, and gave it as his opinion that it would be very undesirable to set up this new standard of 25 cycles. He thought the companies could do all that was necessary if they had extended powers.

Mr. BALFOUR BROWNE, K.C., then addressed the Committee on behalf of the petitioning companies. The companies which he represented had, he said, embarked nearly £13,000,000, and had powers to invest about £5,000,000 or £6,000,000 more. Every year they were spending £1,000,000 on their business. The Bill had been put forward as a Bill which was not competitive, but that was not true. If it was not competitive, if it was left to the companies merely to apply to the County Council to take energy from them if they chose, the scheme must be a dead failure. Not one of the companies would touch it. Why should they? If, on the other hand, the expenditure of a large sum belonging to the ratepayers of London was sanctioned, the time would come when Parliament would not be allowed to leave it as a failure on the hands of London. Parliament would be forced to give the Council other powers, and this would mean the ruin of the companies he represented. Were the Committee convinced that the Council could supply more cheaply than the companies? It was a bad scheme, and all the figures which they had had before them had been an attempt—he did not say an unfair attempt—to mislead the Committee. A table had been put in showing the prices of the companies in 1904, while, at the same time, they knew that the prices of the companies had been going down. Mr. Balfour Browne then touched on the history of the companies, and pointed out that their time was running out—only 26 years out of the 42 remaining. Would the Committee, he asked, allow the County Council to put their hands into the ratepayers' pockets in such a speculative business as that of electricity supply? If the Council wished to clear away private enterprise in London let them buy up the companies' £13,000,000 of capital, and they would have a free hand. In conclusion, he said that instead of having the Council behind them, it was better for the companies to stand shoulder to shoulder, as he knew they were able to do. He was sure that that would tend to an efficient supply of electricity for London, and one that would be just to the companies.

THURSDAY, JUNE 14TH.

Sir RALPH LITTLER, K.C., addressed the Committee on behalf of the opposition of the City Corporation. The City, he pointed out, was the only municipal authority in London which possessed absolutely full municipal powers, and it was therefore in a different category from the Borough Councils. The Corporation had given very great care to the consideration of the question of the electric supply, for it had peculiar means of considering it by reason of its constitution. The City represented the commerce and trade of the heart of the Empire, and naturally would give particular attention to anything which was likely either, on the one hand, to advance that trade or to injure it. The City paid $\frac{1}{8}$th of the rates of the whole metropolis, and anything which was likely to effect those rates was therefore of the greatest importance to it. There was another way in which the City was distinguished from every other authority in London, and that was as to the Electric Lighting Orders under which it was at present supplied by the Charing Cross Co. and the City of London Co. Their time for compulsory purchase came on as early as 1913, so that in seven years from the present time it would be in a position to acquire the undertakings of the existing statutory companies. There were also special conditions under which those undertakings were to be acquired. The streets of the City were, he might say, absolutely full of mains of every description, and the Corporation would not allow anyone to do anything in the City in regard to the laying of mains without its consent. The City did not want the supply of the L.C.C., and did not want their mains. It was recognised last year by the promoters of the Administrative County Bill that there would be no demand for power in the City, and the same condition applied now. There were no docks, no tramways, no canal or water works in the City, and the only railways within the area—the Central London, the City and Waterloo, the City and South London, the Metropolitan, and the Metropolitan District—were already supplied with electricity from their own sources. Continuing, Sir Ralph said that of all forms of administration for vast industrial undertakings, the best of all had been found to be private ownership; next to that, companies where there was control by a board of directors, most of them skilled men; and the least advantageous form of all was where the conduct was through a municipal authority. He would not use the word worst, but it was the least good of all those three forms. This undertaking was to be an enormous one, if it was to be of any use at all. But it required the most absolute skill, very great knowledge, and, in addition, a very great deal of courage—courage to dare to do what Mr. Merz had told them had already been done, and what he ventured to think, seeing the progress of electricity, would happen more and more in future—the courage to scrap any portion of the works which had become, not obsolete, but long before it had become obsolete. That could be done by those who had an intimate knowledge, and who had not the fear of the taxpayer behind them. Therefore, he contended the L.C.C. was not the body to which such an undertaking ought to be entrusted. Learned counsel then went on to deal with the debt of London, and coming back to a consideration of the scheme, pointed out that the L.C.C. was by no means unanimous in its adoption of the scheme, and remarked that the Finance Committee, under Lord Welby's chairmanship, had warned the Council about incurring additional responsibilities.

The CHAIRMAN of the Committee asked if in the purchase by the City of the undertakings of the two companies the power stations would be included.

Sir RALPH replied that that was so. They had power to acquire both the power stations, although they were outside the City of London boundary. Continuing, Sir Ralph compared the L.C.C. scheme with that of the Administrative Co. The voltage proposed by the L.C.C., he said, was 6,600. Last year Mr. Merz proposed 12,000, and this year he was not content with anything less than 20,000 volts. Therefore they found the L.C.C. starting with a scheme which was already antiquated. Again, the whole completed scheme of the L.C.C. would provide only some 65,000 or 66,000 KW., whereas Mr. Merz said that what was wanted was 435,000 KW. Then the Bill was only permissive, and proper provision was not made for the manufacturers. In conclusion, he asked the Committee not to pass the Bill, or, if it should pass, to exclude the City from its area.

Mr. FREEMAN, K.C., then replied for the L.C.C. He said that what struck him very forcibly in reading the case which had been put against the Bill was that they had had two rival theories of criticism, which were to a large extent mutually self-destructive. They had had a certain amount of criticism which was represented by the Administrative Co.'s case; they had a certain amount which was represented by the local authorities and some of the companies, and they had a third opposition, which was partly one and partly the other, and was represented by the companies for whom his friend, Mr. Balfour Browne, appeared. As regards the Administrative Co.'s scheme, what they said was this on the broadest possible lines:—That there must be a central supply if they were to supply cheaply; that that supply should be from as few stations as possible; that those stations should be selected with the greatest facilities as to water carriage and distribution; and that the area should be large enough to enable an economical supply to be given. That was, broadly, the principle of the Administrative Co., and it was also the principle on which the L.C.C. proceeded too. But when he turned to the local authorities and the companies' cases he found that their attitude was exactly the reverse. It was an attitude of *non possumus*. They said: "Do not bring in this large scheme; have things as they are; we are perfectly capable of doing the work; we can supply in our own district as Parliament intended we should, and that we should ultimately be possessors of the works. Do not do anything to interfere with us, and do not come into competition with us." That was the attitude taken up last year against the Administrative Co.'s Bill, and it was the attitude which was generally taken up by the local authorities who appeared, certainly in the first house, in a united opposition against the Bill, and it was the attitude of the City Corporation. They were two lines of opposition which could never meet, because whatever was conceded to the Administrative Co. must necessarily be contrary to the proposals of the local authorities, and *vice versâ*. Learned counsel dealt with the opposition of the various companies in detail, going at great length into the case of the Administrative Co. He concluded his argument by saying that the point of the L.C.C. was this. They believed that the Bill was one which would, if

passed, act as a stand-by without taking business from the people who had at present acquired the right to do it. They believed that it would be a public, a municipal, and even a national advantage; and because it was the only tangible scheme now before Parliament he asked the Committee to pass the Bill.

At the conclusion of learned counsel's speech, the CHAIRMAN said that the Committee proposed to take some independent evidence which would be submitted to them on Tuesday. They might also have further evidence brought before them by the Admiralty and by the Board of Trade. The Committee would be at liberty on Wednesday, if arrangements could be made for visiting the Greenwich station. It was understood that the Committee would visit the station about noon.

The Committee then adjourned until Tuesday.

(To be continued.)

London Outer Circle Railway.

(*Continued from page* 959.)

On Thursday and Friday last week several witnesses were called on behalf of the opposition of the various railway companies. The evidence tended to show that in the opinion of most of the witnesses the line would not be successful commercially.

Sir FREDERICK HARRISON, the general manager of the London and North-Western Co., said that the line was not laid out to earn £415,000 from passenger traffic by the year 1911. Such a thing was not at all probable, and even if the passengers coming into London by half-a-dozen lines were transferred to the proposed line, still the proposed outlay would not be justifiable.

Mr. VINCENT HILL, of the South-Eastern and Chatham Co., and other witnesses gave similar evidence.

Mr. J. SMITHER, accountant to the North London Railway, gave some particulars of the early history of that railway. His view was that the present project was far in advance of its time.

MONDAY, JUNE 18TH.

Mr. MOON, K.C., addressed the Committee on behalf of the Great Western and Midland Companies. On the question of the financial aspect of the scheme, he said that no assurance could be found that the capital would be raised. Lord Avebury's name had been mentioned in the matter, but when his Lordship came and gave evidence, it appeared that he was only an ornamental witness.

The CHAIRMAN observed that it was not merely as an ornamental witness that Lord Avebury gave evidence. He had spoken of the public advantage of the scheme.

Mr. MOON, continuing, said that in any case Lord Avebury's evidence had not advanced the promoters' case. All that he had done had been to give the financial gentlemen connected with the scheme good characters. But there was no evidence to show that those gentlemen were really backing the scheme. No one had expressed his intention of supporting the scheme financially.

The CHAIRMAN remarked that taking the financial evidence by itself, they felt that that evidence was such as would satisfy them.

Mr. MOON said that if the Committee did not wish to hear him on the question of actual finance, he would confine his remarks to other matters, but he wished respectfully to remind the Committee that no witness had said definitely that he would financially support the scheme. Really the whole project was a "wild cat" scheme. The promoters, if they got their powers, would go to the other railway companies and say, "Here is a cat which will scratch the eyes out of your company; what will you give us for it?"

The CHAIRMAN said that if another company took over the scheme and carried it out the public would get the railway.

Mr. MOON said that there was not much chance of any company carrying out the scheme.

The CHAIRMAN: But the cat must jump into somebody's lap.

Mr. MOON: Not necessarily. All the promoters wanted was a scheme which they could dispose of. He asked the Committee to put an end to this cat before it got its eyes open.

Mr. GRANT, assistant general manager to the Midland Railway Co., was then called, and went at some length into the methods by which goods were transferred from the northern lines to those on the south of the river. If constructed the line would not be made use of by the Midland Co., as they had joint interests with other companies in existing means of communication. No complaints had been made, and the companies were well able to provide for any extension of traffic. There was no prospect, that he could see, of the proposed line earning £250 per mile per week. While the proposed line would do no good to the Midland, he did not think it would do much harm.

By the CHAIRMAN: It was an attractive scheme at first blush, but when one came to look into it its real nature became evident.

Mr. GOODAY, general manager of the Great Eastern Railway Co., formerly general manager of the L.B. & S.C. Railway, also gave evidence.

(To be continued.)

Derbyshire and Nottinghamshire Electric Power Bill.—This Bill came before the Unopposed Bills Committee of the House of Commons on Thursday last week. The measure is promoted for the purpose of altering and regulating the capital and borrowing powers of the company; to extend the powers of the company for the supply of energy within their statutory area; to make agreements with local authorities, companies or others for the supply of electricity, and for other purposes. It is provided that the directors of the company may, if so authorised by a general meeting of the company, raise such portion of the capital authorised to be raised under the Act of 1901 not exceeding £500,000 in the same manner, and subject to the same terms, &c., as if such portion of capital were additional capital. The company also take power to lay electric lines, cables, &c., above ground within the area of supply, and to enter into contracts for supplying current in bulk. A further clause relates to the purchase of part of the Nottinghamshire and Derbyshire Tramways. Mr. Bell, the Parliamentary agent, in the course of his explanation of the Bill, said that he understood that a Bill had been sanctioned allowing 10 per cent. commission for the underwriting of the capital of a company.—The Chairman remarked that the Committee considered that that commission should be cut down to 7½ per cent.

Petitions.—The British Electric Traction Co. and the Yorkshire Electric Tramways have lodged a petition against the Gomersal Electric Lighting Order in No. 4 Confirmation Bill. The Twickenham and Teddington Urban District Councils are petitioning against the Twickenham and Teddington Electric Supply Bill.

Haslingden Corporation Bill.—The Police and Sanitary Committee, presided over by Mr. J. W. Wilson, which has considered the Bill promoted by the Haslingden Corporation, has found the preamble proved. Amongst other matters the Bill provides for the reconstruction and electrification of the existing tramways and for working arrangements with the Corporations of Accrington and Rawtenstall. The extracts in the Bill were £38,000 for the purchase of existing tramways, £12,000 for reconstruction, £25,000 for new tramways, £25,000 for equipment, and £3,000 for the purchase of motors. The Committee allowed eight years for the completion of the new tramways to be authorised by the Bill, having regard to the fact that it was not expedient that they should be commenced until the existing tramways in the borough had been acquired by the Corporation and adapted for working by electric traction, and to the desirability of testing the traffic on the new routes by means of motor-omnibuses. They further fixed 25 years for the repayment of the sum necessary for the purchase of the existing tramways; 30 years for the money necessary for the reconstruction and the construction of tramways, 20 years for the £12,000 for the electrical equipment, and 10 years for £8,000 for rolling stock.

Electric Lighting Provisional Orders (No. 3) Bill.—When this Bill was before the House of Lords on 15th inst. it was complained that Provisional Order procedure was very unsatisfactory at present. Neither the Bills themselves nor the amendments affecting them had been circulated among members of the House. It was resolved to postpone further consideration of the Bill.

Electric Lighting Provisional Orders (No. 5) Bill.—This Bill was considered by the Unopposed Bills Committee of the House of Commons on Thursday last week. The orders with which the Bill deals are as follows:—Bude, Camberley and District, East Barnet Valley, Exeter (extension), Frome (amendment), Higham Ferrers, Rushden and Wellingborough (Rural District), Mid-Durham, Wealdstone, Wisbech (amendment), and Yardley (amendment). The Bill was ordered to proceed.

Electric Lighting Provisional Orders (No. 6) Bill.—This Bill was also before the Unopposed Bills Committee of the House of Commons on Thursday last week. The two orders with which the Bill deals are those of Eastwood and Cathcart and Kilpatrick, both of which are granted to the Strathclyde Electric Supply Co., Ltd. The Bill was ordered to proceed.

Wireless Telegraphy Bill.—In the House of Lords last Friday this Bill was read a third time and passed.

The Working of Electric Trains.—A member of the House of Commons asked on the 14th inst. whether the B. of T. considered it satisfactory to work electric trains with only one man in the motor-cab. It reply it was said that there had not been any accidents arising from this circumstance, and there was no reason for regarding that system of working as dangerous.

Buenos Ayres Grand National Tramway Co.'s Bill.—This measure, which deals with arrangements in regard to the arrears of dividend on the preference and second preference shares, and with the rearrangement and increase of the capital of the company, was considered by the Unopposed Bills Committee of the House of Commons last week.

Second and Third Readings.—In the House of Commons on Wednesday, June 13th, the Southport and Lytham Tramroad (Extension of Time) Bill was read a second time.

In the House of Lords on 14th inst., the North and South Shields Electric Railway Bill, the Ascot District (Electric Lighting) Bill and the Brixham Gas (Electric Lighting) Bill were read a second time. The Folkestone and District Electricity Supply Bill was read a third time. The Cork City Railways and Works Bill passed its third reading.

In the House of Lords on Friday, June 15th, the following Bills were read a second time:—Twickenham and Teddington Electric Supply Bill and London United Tramways Bill. The following Bill was read a third time and passed:—Kent Electric Power Bill.

In the House of Commons on Monday, the Hackney Electricity Bill was considered and read a third time.

In the House of Lords on Monday, the Shropshire, Worcestershire and Staffordshire Electric Power Bill was read a third time.

In the House of Lords on Tuesday, the following were read a second time:—North-East London Railway Bill, Baker Street and Waterloo Railway Bill, Lancashire Electric Power Bill, St. Pancras Electricity Bill, Metropolitan District Railway Bill, North-West London Railway Bill, Metropolitan Railway Bill, and the Hackney Electricity Bill.

Oldham and Saddleworth District Tramways Bill.—This Bill, which seeks to abandon the authorised undertaking, wind up the company and release the deposit money, was before the Chairman of Ways and Means as an unopposed Bill on Thursday, and was ordered to go for third reading.

Hackney Electricity Bill.—The Bill promoted by the Metropolitan Borough Council of Hackney for the purpose of making further provision in regard to that Council's electricity supply undertaking, came before the Unopposed Bills Committee of the House of Commons on Thursday last week. The provisions of the Bill relate to agreements for supplying energy in bulk, the supply of electric fittings and the supply of current to premises having a separate supply. Power is sought to acquire a piece of land on the western side of the Navigation Cut of the Lea, adjoining land already in the possession of the Council, for the purpose of erecting additional buildings in connection with the generating station. The Bill was ordered to proceed.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer.]

"CONSUMED" writes:—"In further reference to our letter signed "Consumed," and to which you were good enough to reply in your issue of June 1st, we beg to give you the following information, and enclose a copy of the contract form for the supply between the .... Corporation and their consumers. The particular installation in question is .... and we give you this information so that you may know the circumstances, and we would be very much obliged if you would be so good as to reply further to this case."

*** The "Application form" which "Consumed" has forwarded does not throw much light upon the problem under discussion. The question was whether electricity which passes through the shunt of a meter can be said to be consumed or not? It appears that in supplying electricity to a building where there are a number of consumers, a certain corporation has made an arrangement with the landlord under which he pays for current supplied according to the register of a "master meter." Each consumer also has a meter, and it is found that there is a difference in the reading of the master meter and the sum of the readings of the sub-meters, owing to the fact that the shunts of the sub meters are in circuit day and night, and the work done by them is recorded in the master meter. "Consumed" has to pay for all that passes through the master meter, although he can only collect the smaller amounts from the individual consumers. The question is—Is he liable? There is nothing, apparently, in his contract with the corporation which makes provision for the loss. The contract provides that "The amount of energy supplied to any ordinary consumer under the Electric Lighting Order shall be ascertained by means of a meter .... certified to be in proper working order for correctly registering the amount of energy supplied."

In the absence of any authority on the point, it is thought that the corporation have no right to charge for electricity which is not consumed. In the case of an ordinary consumer who has a single meter, the supply authority, not the consumer, bears the loss of leakage through the by-pass. "Consumer" is recommended to consult a solicitor, who will advise him as to how best to test this question in a court of law.

Electrically-Heated Woven Fabrics.—A recent number of *L'Electricité* contains an account of C. Herrgott's process for producing woven materials suitable for electric heating purposes. A special flexible resistance wire, which can be drawn of any required section, is used, and is uniformly interwoven with the ordinary material of the cloth. The resulting material, whether composed of hemp, cotton, wool or silk, and whether heavy or light in texture, is not noticeably different from the same material without the electric heating wires. All strain is taken by the textile material, so that the conducting part can be safely made of extremely small section, and offers a large heat radiating surface.

The large number of circuits employed enables the voltage between neighbouring conductors to be kept down to from ½ to 1 volt, and so prevents all danger from short circuits. Current is lead to the various groups of conductors in parallel by means of special leading-in wires running along the opposite edges of the cloth. Carpets, bed-covers, foot-warmers, &c., are made up on this principle, and offer a safe and effective method of internal heating. It is only necessary to connect the leading-in wires to the electric supply through a suitable fuse and switch in order to raise the surface of the material to a uniform moderate temperature, which is usually 30° to 35° C. above the atmosphere in the case of carpets, and 20° to 25° C. in the case of foot-warmers, &c.

Amongst the many applications to which this system of heating lends itself are the medical treatment of rheumatism and other cases requiring the application of a gentle heat locally; the filtering of syrupy liquids, which have to be treated at a definite temperature, the drying of paper by passing it over endless bands of the heated cloth, and the construction of compact foot-warmers for tramway and railway carriages.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

4,951A. "Improvements in or relating to electricity meters." O. PAULET. (Date applied for under Patents Act, 1901, June 6th, 1905, being date of application in Germany.) An invention comprised in Application No. 4,951, dated February 28th, 1906. June 5th. (Complete.)

12,974. "Storage battery." R. B. ALLEN. June 5th.

12,998. "Wireless lamp clusters." W. FAIRWEATHER. (The Benjamin Electric Manufacturing Co., United States.) June 5th. (Complete.)

13,000. "Improved operating gear for groups of electrical switches or rheostats." W. DEFRIES. June 5th.

13,023. "Improved process for oxidising liquids with aid of electric discharges." A. DE HEMPTINNE. June 5th.

13,032. "Improvements relating to electric heating and cooking apparatus." R. H. CRIPPS. June 5th.

13,034. "Improvements in or relating to the electrical control of electrically propelled vehicles and other installations where the load is very variable." S. T. WEBSTER. June 5th.

13,050. "A switchboard cord reel." J. E. KINGSBURY. (The Western Electric Co., United States.) June 5th.

13,059. "Improvements in insulated conductors." F. KUHLO. June 5th. (Complete.)

13,065. "Improvements in electro-magnetic clutches." W. SCHUSTER and H. AST. June 6th. (Complete.)

13,066. "Improvements in electro-magnetic clutches." W. SCHUSTER and H. AST. June 6th. (Complete.)

13,067. "Improvements in electro-magnetic clutches." W. SCHUSTER and H. AST. June 6th. (Complete.)

13,069. "Improvements in or relating to the arrangement of the winding of electro-magnetic clutches." W. SCHUSTER and H. AST. June 6th. (Complete.)

13,078. "Improvements in end connections for conductors on field magnets of alternate current generators." M. WALKER. June 6th.

13,085. "An improved hoisting gear, especially applicable for raising and lowering arc lamps." VERITYS, LTD., and F. S. WORSLEY. June 6th. (Complete.)

13,117. "Electrical device for recording the breaking of a fire prevention sprinkler." W. G. MEDDINGS. (Date applied for under Patents Act, 1901, January 18th, 1906, being date of application in New Zealand.) June 6th. (Complete.)

13,127. "Improvements in the electrolytic refining of copper." S. O. COWPER-COLES. June 6th.

13,167. "Improvements in tramway trolley-poles and the like." R. H. HISLOP. June 7th. (Complete.)

13,172. "Improvements in or relating to reflector mountings for electric incandescent lamps and the like." P. DRUSEIDT. June 7th. (Complete.)

13,180. "Improvements in or relating to electric switches." R. MELHUISH. June 7th.

13,201. "Improved guard for the mouthpiece of telephonic transmitters." G. E. GRIMM. (Date applied for under Patents Act, 1901, August 5th, 1905, being date of application in United States.) June 7th. (Complete.)

13,221. "Improvements in and relating to electric switches." THE BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) June 7th.

13,222. "Improvements in devices for controlling electric circuits." THE BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) June 7th.

13,285. "Improvements in and relating to the control of alternating-current motors of the induction type." THE BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) June 8th.

13,286. "Improvements in and relating to systems of distribution employing vapour rectifiers and the like." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) June 8th.

13,287. "Improvements in and relating to systems of operating electrically-propelled vehicles." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) June 8th.

13,304. "Improvements in means for joining and bonding rails for electric traction." D. CROWTHER. June 9th.

13,311. "Improvement in telephone dictating machine or apparatus." W. G. HEYS. (K. M. Turner, United States.) June 9th. (Complete.)

13,312. "Improvements in telephone exchange systems." W. AITKEN. June 9th. (Complete.)

13,313. "Improvements in controlling gear for electrically-driven pumps." H. SMITH & Co., LTD., H. SMITH and O. SMITH. June 9th. (Complete.)

13,326. "Improvements in tools to be used in removing the metal sheathing from the ends of metal sheathed electrical conductors where connections are to be made." E. L. BERRY and F. HARRISON. June 9th. (Complete.)

13,331. "Improvements in and relating to safety gates or closures for motor-cars and other vehicles applicable, also as an electric safety system for elevators and other purposes." J. A. MILLER. June 9th. (Complete.)

13,332. "Improvements in electric motor-generators." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) June 9th.

13,336. "Improvements relating to electric switches and cut-outs." C. CAREW-GIBSON. June 9th.

13,337. "Improvements in and relating to electric switches." E. NEUDORFFER. June 9th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

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ELECTRIC FUSE BOXES. British Thomson-Houston Co. (General Electric Co. 13,974. July 6th.

ELECTRIC LIFTS WITH ELECTRO MAGNETIC CONTROL. C. G. Major, E. C. Stevens and P. H. Stevens. 15,365. July 26th.

ELECTRIC CANDLE LAMPS. C. C. Regnart. 17,288. August 26th.

ELECTRICAL BLOCK SIGNALLING APPARATUS. J. McIlwain and C. A. Bennett. 20,690. October 12th.

ELECTRIC INCANDESCENCE LAMPS WITH METALLIC FILAMENTS. W. P. Thompson. (Deutsche Gasglühlicht Akt.-Ges. Auergesellschaft.) 22,353. November 1st.

SWITCHES FOR USE WITH INCANDESCENT ELECTRIC LAMPS. F. Harrison. 24,452A. (Date applied for under Rule 5, Patents Rules 1905, November 27th, 1905.)